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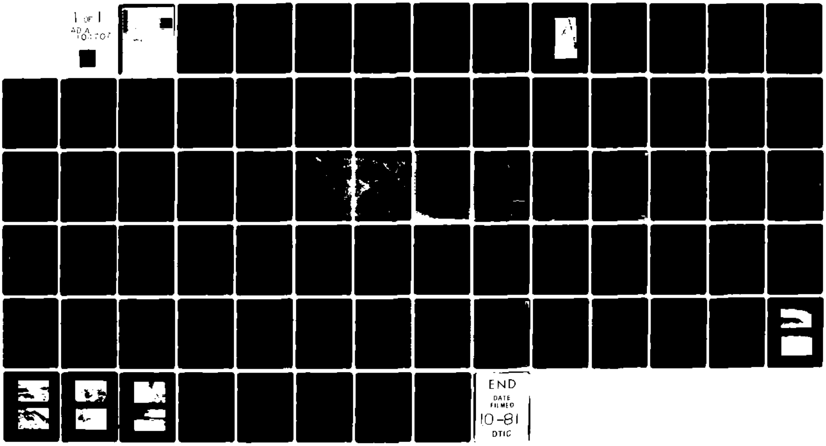

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This report was prepared under the National Program of Inspection of Non-Federal Dams. This report assesses the general condition of the dam with respect to safety, based on available data and on visual inspection, to determine if the dam poses hazards to human life or property.

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DEPARTMENT OF THE ARMY
ST. LOUIS DISTRICT, CORPS OF ENGINEERS
210 NORTH 12TH STREET
ST. LOUIS, MISSOURI 63101

IN REPLY REFER TO

SUBJECT: Claymont Woods Lake Dam Phase I Inspection Report

This report presents the results of field inspection and evaluation of the Claymont Woods Lake Dam.

It was prepared under the National Program of Inspection of Non-Federal Dams.

The St. Louis District has classified this dam as unsafe, non-emergency because the principal spillway will not pass 50 percent of the Probable Maximum Flood and the auxiliary spillways, necessary to provide the required outlet capacity for the specified spillway design flood, are subject to failure by erosion in their present condition.

SUBMITTED BY: SIGNED 26 SEP 1978
Chief, Engineering Division — Date

APPROVED BY: SIGNED 26 SEP 1978
Colonel, CE, District Engineer — Date

CLAYMONT WOODS LAKE DAM
ST. LOUIS COUNTY, MISSOURI

MISSOURI INVENTORY NO. 10489

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM

PREPARED BY:

HORNER & SHIFRIN, INC.
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FOR:

U.S. ARMY ENGINEER DISTRICT, ST. LOUIS
CORPS OF ENGINEERS

SEPTEMBER 1978

HS-7848

PHASE I REPORT

NATIONAL DAM SAFETY PROGRAM

Name of Dam:	Claymont Woods Lake Dam
State Located:	Missouri
County Located:	St. Louis
Stream:	Creve Coeur Creek
Date of Inspection:	2 June 1978

The Claymont Woods Lake Dam was visually inspected by engineering personnel of the office of Horner & Shifrin, Inc., Consulting Engineers, St. Louis, Missouri. The purpose of the inspection was to assess the general condition of the dam with respect to safety and, based upon this inspection and available data, determine if the dam poses a hazard to human life or property.

Based on a visual inspection, the present general condition of the dam and spillway is considered to be satisfactory. The following deficiencies were noticed during the inspection and are considered to have an adverse effect on the overall safety and future operation of the dam and spillway:

1. Minor erosion of the side slopes of the dam and embankment section on the right side (looking downstream) of the principal spillway, as well as some minor surface cracking, was noticed. Some minor raveling of the earthen banks at the lake waterline was also observed. Erosion will reduce the embankment cross section and could result in instability and/or overtopping.

2. The riprap in the outlet channel immediately downstream from the principal spillway, for a distance of approximately 10 feet, was displaced apparently due to the scouring effect of spillway discharge. Continuing erosion at this location could undermine the spillway.

3. An abundance of small willow trees and other vegetation were observed growing in the spillway outlet channel. Obstructions in the outlet channel could affect its capacity to pass spillway discharge at the rate required to prevent flooding of the area adjacent to the downstream toe of dam. Flooding of this area can be detrimental to the stability of the dam since the presence of water can saturate the soil and reduce its effective strength.

4. Numerous trees and brush exist on the dam backslope at and in the drainage ditch paralleling the dam. This growth will restrict ditch flow that may result in flooding of the area adjacent to the dam. As mentioned in paragraph 3, flooding of this area may impair the stability of the dam.

The conditions described above are not considered to be serious at this time.

Engineering drawings of the dam indicated the embankment (earth fill) sections adjacent to the principal spillway were to be constructed to elevation 561.0, or 4.0 feet lower than the top of the dam. Surveys performed at the time of the inspection revealed that these embankment sections were actually constructed as low as elevation 561.4. It was assumed that these relatively low embankment sections were intended to function as auxiliary spillways if lake outflow conditions required outlet capacity in addition to that provided by the principal spillway. The inspection also disclosed that these embankments were constructed of materials (clayey silts, silty clays, containing fine sand) and with relatively steep (1v on 3h) unpaved downstream slopes which are considered to be highly erodable when subjected to the flow of water.

According to the criteria set forth in the recommended guidelines (see text) the minimum spillway design flood for this dam, which is classified as

small in size and of high hazard potential, is specified to be one-half Probable Maximum Flood (1/2 PMF). PMF is the flood that may be expected from the most severe combination of critical meteorologic and hydrologic conditions that are reasonably possible in the region. Results of a hydrologic-hydraulic analysis indicated the existing principal spillway to be inadequate to pass lake outflow resulting from a storm of 1/2 PMF magnitude, or the outflow resulting from the 1 percent chance (100-year frequency) flood. The length of the downstream damage zone, should failure of the dam occur, is estimated to be 2 miles.

It was found by hydraulic analysis that the capacity of the principal spillway, without allowing the lake water level to exceed elevation 561.4 (the crest of the auxiliary spillway), is about 1,160 cfs (0.15 PMF). A spillway flood of 1/2 PMF magnitude would require the lake water surface to rise to elevation 563.5, or 2.1 feet higher than the crest of the auxiliary spillway. Therefore, it is believed that floods greater than 1,160 cfs will require use of the auxiliary spillway sections and possibly cause failure by erosion of these embankments with their steep (1v on 3h) unpaved slopes.

A review of available data did not disclose that seepage and stability analyses of the dam were performed. This is considered a deficiency and should be rectified.

It is recommended that the owner take the necessary action in the near future to correct or control the deficiencies and safety defects reported herein.

Albert B. Becker, Jr.

Albert B. Becker, Jr.
P.E. Missouri E-9168

OVERVIEW OF LAKE AND DAM

PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
CLAYMONT WOODS LAKE DAM - ID NO. 10489

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PHASE I INSPECTION REPORT
NATIONAL DAM SAFETY PROGRAM
CLAYMONT WOODS LAKE DAM - ID NO. 10489

SECTION 1 - PROJECT INFORMATION

1.1 GENERAL

a. Authority. National Dam Inspection Act, Public Law 92-367, dated 8 August 1972.

b. Purpose of Inspection. The purpose of this visual inspection was to make an assessment of the general condition of the dam with respect to safety and, based upon available data and this inspection, determine if the dam and spillway pose a hazard to human life or property.

c. Evaluation Criteria. This evaluation was performed in accordance with the "Phase I" investigation procedures as prescribed in "Recommended Guidelines for Safety Inspection of Dams," Appendix D to "Report of the Chief of Engineers on the National Program of Dams," dated May 1975.

1.2 DESCRIPTION OF PROJECT

a. Description of Dam and Appurtenances. The Claymont Woods Lake Dam is an earthfill type embankment rising approximately 20 feet above the original stream bed. Lake level is governed by a concrete overflow type spillway with the weir section approximately 40 feet in length. The elevation transition, about 11.2 feet. from the weir to the downstream end of the concrete spillway takes place in approximately 79 feet. The spillway outlet channel joins Creve Coeur Creek at a point roughly 60 feet downstream from the spillway. Inspection of the dam site, as well as a review of available engineering plans, revealed that the embankments adjacent to the concrete (principal) spillway

were constructed to an elevation approximately 3.6 feet lower than the crest of the dam. It was assumed that the purpose of these lower sections was to allow them to function as auxiliary or emergency spillways should flood conditions not contemplated or unforeseen in the design of the principal spillway occur.

No evidence of a lake drain pipe was noticed. A storm drainage ditch, with a 96-inch pipe culvert at the upstream end, runs parallel to and about 90 feet (per survey measurement) east of the dam centerline. A plan of the lake, dam and appurtenances is shown on Plate 2.

b. Location. The dam and lake are located on Creve Coeur Creek in the subdivision of Claymont Woods, approximately 6 miles west of Creve Coeur, Missouri, in St. Louis County, as shown on the Regional Vicinity Map, Plate 1. The dam is located in U.S. Survey 2011, Township 45 North, Range 4 East, immediately upstream of the Baxter Road crossing of Creve Coeur Creek.

c. Size Classification. The classification for size based on the height of the dam and storage capacity is categorized as small. (Per Table 1, Recommended Guidelines for Safety Inspection of Dams.)

d. Hazard Classification. According to the St. Louis District, Corps of Engineers, the Claymont Woods Lake Dam has a high hazard potential, meaning that the dam is located where failure may cause loss of life, serious damage to homes, extensive agricultural, industrial and commercial facilities, important public utilities, main highways, or railroads. The estimated flood damage zone, should failure of the dam occur, as determined by the St. Louis District, extends two miles downstream of the dam. Within this possible damage zone are ten homes and two bridges which are on Baxter and Schoettler Roads.

e. Ownership. The dam is owned by the Claymont Woods Residents Association, Inc. The current president of the Association, Mr. Hubert Willman,

resides at 1567 Estuary, Ballwin, Missouri, 63011. The association presently consists of 225 home and/or property owners.

f. Purpose of Dam. The dam impounds water for the purpose of recreation for surrounding residential property owners, who are members of the Claymont Woods Residents Association, Inc.

g. Design and Construction History. In 1969, the Elbring Surveying & Engineering Company of Clayton, Missouri, prepared for the Mayer-Raisher-Mayer Construction Co., the developers of the Claymont Woods Subdivision, the original plans for construction of the lake and dam. The firm of Brucker and Thacker, Consulting Engineers, Brentwood, Missouri, was retained by the Elbring Company to provide expertise in the design of the dam. In 1970 Metron, Inc., St. Louis, Missouri, was retained by the developer to revise the plans prepared by the Elbring Co. Revisions to the original plans were limited primarily to relocation of the principal spillway and to the length of low embankment section to be constructed. Construction of the dam and spillway was completed in 1971.

h. Normal Operational Procedure. The lake level is regulated by overflow of an uncontrolled spillway.

1.3 PERTINENT DATA

a. Drainage Areas. The areas tributary to the lake are primarily suburban residential with lot sizes ranging from about one-half to one acre. A private country club with a golf course and a small shopping center lie within the area. The watershed above the dam is approximately 1.6 miles long. The total watershed area is approximately 661 acres. The watershed area is outlined on Plate 1.

b. Discharge at Damsite.

(1) Estimated known maximum flood at damsite ... 140 cfs[(1)]

(2) Principal spillway capacity ... 1,160 cfs[(2)]

(3) Total (principal + auxiliary) spillway capacity (incremental) ... 9,350 cfs[(3)]

c. Elevation (ft. above MSL). Elevations given below are based on the elevation (557.0) shown on Plate 3 for the upstream end of the concrete spillway and assumed to be correct.

(1) Top of dam ... 565.0 (min.)

(2) Maximum pool (design surcharge) ... 563.5[(4)]

(3) Normal pool ... 557.7 (crest of principal spillway weir)

(4) Auxiliary spillway crest ... 561.4 (min.)

(5) Streambed at centerline of dam ... 545.5±

(6) Outlet channel at junction with creek ... 543.3

(7) Maximum known tailwater ... 549.9[(5)]

d. Reservoir.

(1) Length of maximum pool (elevation 563.5) ... 2,700 ft.[(4)]

(2) Length of normal pool (elevation 557.7) ... 1,000 ft.

e. Storage.

(1) Normal pool ... 49 ac.ft.

(2) Design surcharge (incremental) ... 44 ac.ft.[(4)]

(3) Top of dam (incremental) ... 12 ac.ft.

(1) Water surface to elevation 558.5 (high water mark per resident living adjacent to lake).
(2) Water surface to elevation 561.4.
(3) Water surface to elevation 565.0.
(4) For 1/2 PMF as determined by hydrologic analysis, see Section 5.
(5) Based upon high water mark per resident living adjacent to creek at juncture with spillway channel.

f. Reservoir Surface.

(1) Top of dam ... 10 acres

(2) Maximum pool ... 9 acres(1)

(3) Auxiliary spillway crest ... 8 acres

(4) Normal pool ... 7 acres

g. Dam.

(1) Type ... Earthfill, clay core

(2) Length ... 850 ft. (including spillways and transition to elevation 565.0)

(3) Height ... 20 ft. (max.)

(4) Top Width ... 25 ft.

(5) Side Slopes

(a) Upstream ... 1v on 3h

(b) Downstream ... 1v on 3h

(6) Cutoff ... Earthfill, clay core

(7) Slope Protection

(a) Upstream ... Broken concrete riprap, irregular and intermittent

(b) Downstream ... Grass

h. Principal Spillway.

(1) Type ... Concrete

(2) Approximate length of weir ... 40.5 ft.

(3) Crest elevation (feet above MSL) ... 557.7

(4) Upstream Channel ... Lake

(5) Downstream Outlet Channel

(a) Earth cut, approximate length ... 60 ft.

(b) Bottom width ... 40 ft., broken concrete riprap

(c) Side slopes ... 1v on 2h, broken concrete riprap (in part)

(1) For 1/2 PMF as determined by hydrologic analysis, see Section 5.

i. Auxiliary Spillways.

(1) Type ... Earthfill, clay core

(2) Length ... 350 ft. (total)

(3) Height ... 17 ft.

(4) Top Width ... 15 ft. (min.), 30 ft. (max.)

(5) Side Slopes

  (a) Upstream ... 1v on 3h

  (b) Downstream ... 1v on 3h

(6) Cutoff ... Earthfill, clay core

(7) Slope Protection

  (a) Upstream ... Broken concrete riprap, irregular and/or grass

  (b) Downstream ... Grass

SECTION 2 - ENGINEERING DATA

2.1 DESIGN

a. <u>Subsurface Investigations</u>. Test borings in the lake area and along the centerline of the dam obtained by Brucker & Thacker to determine soil and rock conditions are presented on Plates 6 through 12. A plan showing the location of these borings is presented on Plate 4 and a profile of test holes along the axis of the dam is shown on Plate 5. Test borings (A through F) on the proposed centerline of the dam show the results of Standard Penetration Tests, depths to rock, length of coring, and amount of core recovered. Other borings drilled through the overburden to determine the suitability of the soils in borrow areas (see Plates 13, 14 and 15) for use in construction of the dam were obtained. A review of these test holes indicated that materials available for embankment construction consisted primarily of silty clays and clayey silts with lignite and fine sand throughout.

b. <u>Design</u>. Research did not reveal that stability or seepage analyses of the dam were performed. Specifications prepared by Brucker and Thacker required that a core trench, with a minimum width of 12 feet, be constructed from clean bedrock to elevation 557. Prior to placing fill, cracks in the rock were to be cleaned and sealed with concrete to prevent seepage. The embankment upstream slope was specified to be 1v on 3h and the downstream slope was to be 1v on 2.5h. Core material, clay, was specified to be placed in 8-inch lifts and compacted to a minimum dry density of 88 percent of the maximum dry density per ASTM D-1557. The remaining material in the embankment was also to be placed in 8-inch lifts and compacted to 90 percent of the maximum dry density per ASTM D-1557. Moisture density relationships or plasticity tests of material actually used in the construction of the core or the embankment were unavailable. A cross section of the dam as shown in the specifications is presented on Plate 16.

c. Spillway. Design details indicating the properties of materials to be used or magnitude of the loads applied to design the concrete spillway structure were not available. Structural details for construction of the spillway are shown on Plate 3. Based on measurements made at the time of the visual inspection, it was found that during construction a 9-inch high sill, not shown on the plans, was added to increase the normal pool level to elevation 557.7, and the length of the structure was reduced to approximately 95 feet. The width was maintained at about 40 feet and the wall height at 4.5 feet.

2.2 CONSTRUCTION

Investigations did not reveal that records were kept during construction of the dam or spillway.

2.3 OPERATION

The maximum loading on the dam reported by an owner residing adjacent to the lake was a storm that produced a lake level at about elevation 558.5, 0.8 foot higher than the spillway weir crest. An owner of a home located just downstream from the juncture of the spillway outlet channel and Creve Coeur Creek reported a water level to approximately elevation 549.9, based upon a high water mark, on two occasions within the last 2 years.

2.4 EVALUATION

a. Availability. Sufficient engineering data (based on information obtained in the Brucker & Thacker report) is available to assess the materials used in construction of the dam. Records to verify if construction met specification requirements were not available. No data was available to assess the design of the concrete spillway.

b. Adequacy. Since stability and seepage analyses were not performed, the data available is considered insufficient to thoroughly assess the design of the dam.

c. Validity. Engineering data available is considered to be reasonably accurate and sound.

SECTION 3 - VISUAL INSPECTION

3.1 FINDINGS

a. General. A visual inspection of the dam, principal and auxiliary spillways, and outlet channel was made by Horner & Shifrin engineering personnel on 2 June 1978. Also inspected at this time was the upstream end of the lake at the point where Creve Coeur Creek flows into the lake, and the various bridges crossing Creve Coeur Creek from the dam downstream to Creve Coeur Mill Road. Photographs of the dam and spillway are included on Page A-1 through A-4 of the Appendix. A profile, based on survey data obtained during the inspection, of the dam crest extending through the auxiliary spillways is shown on Plate 17.

b. Dam and Auxiliary Spillway. The upstream and downstream slopes of the dam (see Photos 1 and 2) and auxiliary spillway sections were found to be in good condition with the exception of some minor erosion due to surface storm runoff. Both the crest and upstream side slopes of the embankment to the right (looking downstream) of the concrete spillway, which were intended to be protected by grass, were found for the most part to be sparsely covered. No evidence of lake seepage was noticed along the backslope or drainage ditch paralleling the dam. Trees and brush were present on the backslope at and in the drainage ditch (see Photo 2).

c. Principal Spillway. The fixed crest concrete spillway (see Photos 3 and 4) appeared to be in good condition. No significant deterioration of the concrete due to weathering or damage from ice was observed. Several vertical construction joints, mainly at the junction of the walkway walls with the spillway training walls, showed a joint separation of as much as 1/2-inch (see Photo 8) at the top. This separation is apparently due to differential settlement of adjacent structural sections. No loss of backfill material through these joint openings was apparent.

d. Outlet Channel. The outlet channel between the principal spillway and the creek was found to be in poor condition. The riprap bottom protection adjacent to the end of the principal spillway was partially missing (see Photo 5) for a distance of approximately 10 feet. The remaining riprap, irregular broken sections of concrete slab, was non-uniform in size and randomly placed. The side slopes were protected with riprap, irregular broken sections of concrete slabs, for a distance of about 15 feet from the downstream end of the spillway structure. Willow trees up to 4 inches in diameter were found growing in the channel bottom (see Photo 6) as well as along the side slopes. At the juncture of the channel with the creek (see Photo 7) only a few pieces of broken concrete were found along the bottom and none was noticed along the right (looking downstream) bank.

e. Lake. The bank contiguous to the lake was found to be well maintained and in good condition. A representative of the owner reported that a considerable amount of sediment was present in the lake bottom. No estimate of the quantity or depth of sediment was available.

f. Downstream Channel. The Creve Coeur Creek channel downstream from the dam is unimproved. A second lake, approximately 6 acres in surface area, is located in the subdivision of Claymont Lake Estates and lies about one-half mile downstream from the Claymont Woods Lake Dam. The stream is crossed, beginning at the dam and proceeding downstream by the Baxter Road Bridge, the Schoettler Road Bridge, the K-Woods (private) Road Bridge, the Highway 40 South Outer Road Bridge, the East Bound and West Bound Highway 40 Bridges, the Highway 40 North Outer Road Bridge, the Ladue Road Bridge, the Olive Street Road (Mo. 340) Bridge, and the Creve Coeur Mill Road Bridge. Below Creve Coeur Mill Road the stream emerges onto the flood plain of the Missouri River at a point about 1.2 miles above Creve Coeur Lake. Creve Coeur Lake is approximately 9.7 stream miles below the dam.

3.2 EVALUATION

Deficiencies observed during this inspection and noted herein are not considered of major consequence or of serious potential danger to warrant immediate remedial action.

SECTION 4 - OPERATIONAL PROCEDURES

4.1 PROCEDURES

Since the spillway is a non-gated fixed crest type, there are no means of regulating discharge or the level of the lake. The water surface is governed by rainfall runoff, evaporation, seepage, and the capacity of the uncontrolled spillway.

4.2 MAINTENANCE OF DAM AND AUXILIARY SPILLWAYS

It was reported by a representative of the owner that the grass covered areas of the embankments are mowed occasionally. A sprinkler system installed along the crest of the dam has not been effective in maintaining the grass cover throughout, since both the upstream slope and the crest were sparsely covered. Pieces of broken concrete slab have recently been placed in some areas of the upstream slope at the water line in order to prevent erosion.

4.3 MAINTENANCE OF PRINCIPAL SPILLWAY AND OUTLET CHANNEL

To date, it would appear that little maintenance work has been performed on either the concrete spillway or outlet channel, as is evidenced by the condition of the riprap in the outlet channel bottom and the presence of many small trees growing in the channel bottom and on the side slopes. Also, it appears that no attempt has been made to repair the open vertical joints in the spillway training walls.

4.4 DESCRIPTION OF ANY WARNING SYSTEM IN EFFECT

There is no warning system in effect to alert people living downstream of imminent failure of the dam due to extreme high water. Due to the presence of

numerous homes about the lake, it is likely that adequate warning of dam failure due to overtopping would be given if such a condition was developing.

4.5 EVALUATION

The responsibility of the owner for the maintenance of the dam and its appurtenances is considered a necessary function to the continued safety of the dam. It is recommended that maintenance on a regular basis of the spillway outlet channel, including the banks, be undertaken along with the other normally maintained features.

SECTION 5 - HYDRAULIC/HYDROLOGIC

5.1 EVALUATION OF FEATURES

a. Design Data. The only hydrologic data available is limited to the lake water surface elevations shown on the construction plans for normal water level (elevation 557.0, increased 0.7 feet during construction); 20-year frequency storm (elevation 561.0); and the 100-year frequency storm (elevation 563.0). It appears that the design of the principal spillway was based on the runoff from a 20-year frequency storm, which means a storm that has a probability of occurring once in 20 years.

b. Experience Data. The drainage area and lake surface were developed from the USGS Manchester, Missouri Quadrange Map and construction drawings of the lake area. The dam and spillway layout were obtained from construction drawings modified by surveys made during the inspection.

c. Visual Observations.

(1) The concrete weir and principal spillway are in reasonably good condition. The broken concrete riprap in the discharge channel below the spillway should be restored. Willows and brush growth in the outlet channel should be removed.

(2) Drawdown facilities are not provided to dewater the lake.

(3) The principal (concrete) spillway and auxiliary (earth embankment) spillways are located near the northwest corner of the dam. Spillway releases through the principal spillway section will not endanger the integrity of the dam.

d. Overtopping Potential. The principal spillway section will pass about 15 percent of the PMF just prior to flow taking place over the auxiliary

spillways. Flows of 1/2 PMF, PMF magnitude, and the 1 percent chance (100-year frequency) flood will cause flow to occur over the auxiliary spillways as well as the principal spillway, but will not overtop the dam. The results of a dam overtopping analysis are as follows:

Ratio of PMF	Q - Peak Outflow (cfs)	Max. Lake Water Surface Elev.	Max. Depth of Flow Over Dam (Elev. 591.1)	Duration of Overtopping of Dam (Hours)
0.15	1,160	561.4	0	0
0.50	4,690	563.5	2.1	2.7
1.0	9,430	564.7	3.3	5.8
100-Year Flood	2,820	562.75	1.35	0.8

The flow safely passing the principal spillway just prior to overtopping the auxiliary spillway amounts to about 1,160 cfs, which is the outflow equivalent to about 15 percent of the probable maximum flood, but is less than the 1 percent chance (100-year frequency) flood.

Procedures and data for determining the probable maximum flood, the 100-year frequency flood and the discharge rating curve for flow over the principal and auxiliary spillways are presented on Pages B-1 and B-2 of the Appendix. A listing of the HEC-1DB input data is shown on Pages B-3 through B-5 of the Appendix.

SECTION 6 - STRUCTURAL STABILITY

6.1 EVALUATION OF STRUCTURAL STABILITY

a. Visual Observations. No evidence of instability of the dam, auxiliary spillways, or principal spillway was noticed during the visual inspection of 2 June 1978. Further, no mention of slides or other signs of instability were reported by the owner.

b. Design and Construction Data. Except for the investigations by Brucker & Thacker to determine the soil conditions at the location of the dam, no design or construction data relating to the structural stability of the dam were found.

c. Operating Records. According to a representative of the owner, the dam and spillways have not been monitored in any form during the post construction period. No records have been kept of lake level, spillway discharge, dam settlement, or seepage during this time.

d. Post Construction Changes. With the exception of some riprap placed against the upstream face of the dam, according to a representative of the owner, there have been no changes to these features since completion of the dam and spillway in 1971.

e. Seismic Stability. For this dam, which has a maximum height of about 20 feet, and since the dam is located within a Zone II seismic probability area, an earthquake of the magnitude predicted is not expected to produce a hazardous condition to the dam.

SECTION 7 - ASSESSMENT/REMEDIAL MEASURES

7.1 DAM ASSESSMENT

a. Safety. The embankment sections adjacent to the principal (concrete) spillway are approximately 3.6 feet lower than the top of the dam and were apparently intended to function as auxiliary spillways if conditions warranted. Since it was determined that both the principal and auxiliary spillways would be required for lake outflows greater than 1,160 cfs (1/2 MPF produces an outflow of approximately 4,690 cfs and the one percent [100-year frequency] flood produces an outflow of 2,820 cfs), and since the downstream slopes are steep (1v on 3h) and unpaved, the failure of these embankments when overtopped is a possibility.

A search conducted during this investigation did not disclose that stability or seepage analyses of the dam had been performed.

b. Adequacy of Information. The assessments reported herein with regard to the condition of the dam and appurtenances were based on an external visual inspection and a review of available engineering data. This inspection and data are considered adequate to support the conclusions herein. The assessment on the hydrology of the watershed and capacity of the spillways was based on a hydrologic/hydraulic study as indicated in Section 5.

c. Urgency. The O & M measures recommended in paragraph 7.2b should be accomplished in the near future. The safety defects noted in paragraph 7.1a should be investigated without delay since failure could result from overtopping or instability.

d. Necessity for Phase II. Based on the results of the Phase I inspection, a Phase II inspection is not recommended.

e. Seismic Stability. Since the dam is located in a Zone II seismic design area, an earthquake of the predicted magnitude is not expected to be hazardous to this dam.

7.2 REMEDIAL MEASURES

a. Recommendations. The following actions are recommended:

(1) The auxiliary spillway sections should be modified and/or improved in order to pass the lake outflow resulting from storm runoff of at least 1/2 PMF without danger of failure by erosion when in service.

(2) The owner should obtain the necessary soil data and perform stability and seepage analyses of the dam.

b. O & M Maintenance and Procedures. The following O & M maintenance and procedures are recommended:

(1) Remove the trees, vegetation and debris from the bottom and slopes of the outlet channel below the principal spillway in order to improve its hydraulic capacity and prevent backflooding of the downstream dam area.

(2) Remove the trees and brush on the dam backslope at and in the drainage ditch paralleling the dam in order to improve its hydraulic capacity and prevent backflood of the downstream dam area.

(3) Replace missing or displaced riprap in the spillway outlet channel adjacent to the downstream end of the principal spillway in order to prevent undercutting by scour of the spillway structure.

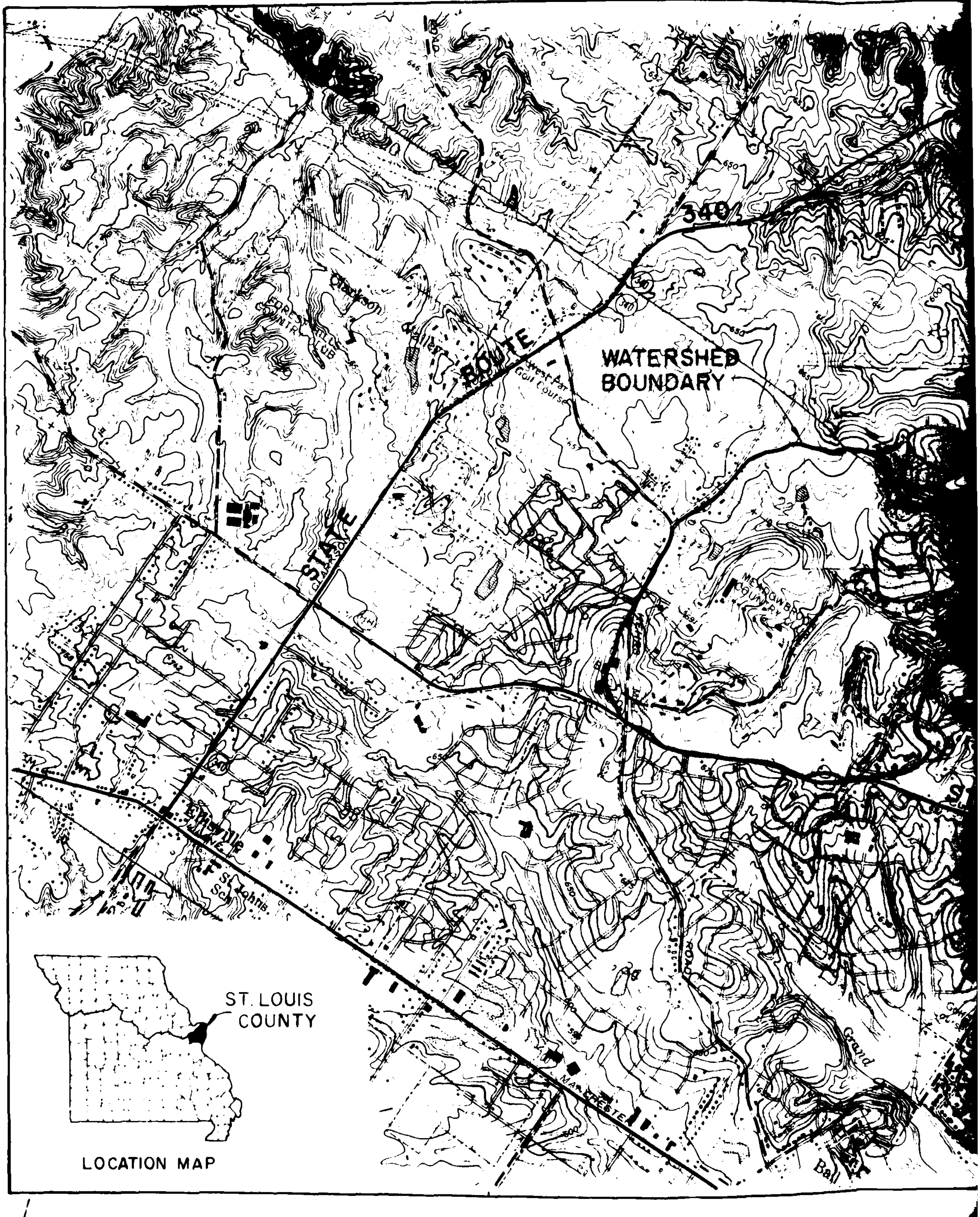
(4) Fill eroded areas and reseed the crest and upstream slopes of the dam and other areas where the existing grass cover is missing or sparse in order to provide protection against erosion by storm water drainage and subsequent loss of section.

(5) Cut the grass on the downstream slope, berm and elsewhere on a regular basis. Grass should not be allowed to grow to a height that hinders inspection of the dam and provides cover for burrowing animals.

(6) Provide uniform riprap slope protection along the upstream slope of the dam and auxiliary spillways to prevent erosion of the section due to lake level fluctuation or wave action.

(7) Seal the open joints in the concrete walls of the principal spillway in order to prevent loss of fill materials through the open joints.

(8) Inspection of the dam and spillway should be instituted on a regular basis by an engineer experienced in the design and construction of earthfill type dams. Records indicating the date of the inspection, the items inspected and their condition, the urgency of any action to be taken in the case where remedial work is deemed necessary, and any additional information considered pertinent should also be included. The names of personnel performing the inspection should also be a matter of record. Copies of these inspection reports should be promptly submitted to the owner for further consideration. It is also recommended, for future reference, that records be kept of all inspections, maintenance work, remedial measures, and improvement at some permanent office.


340
STATE ROUTE
WATERSHED
BOUNDARY
Clarkson
Ellisville
ST. LOUIS
COUNTY
LOCATION MAP
Grand
Ball

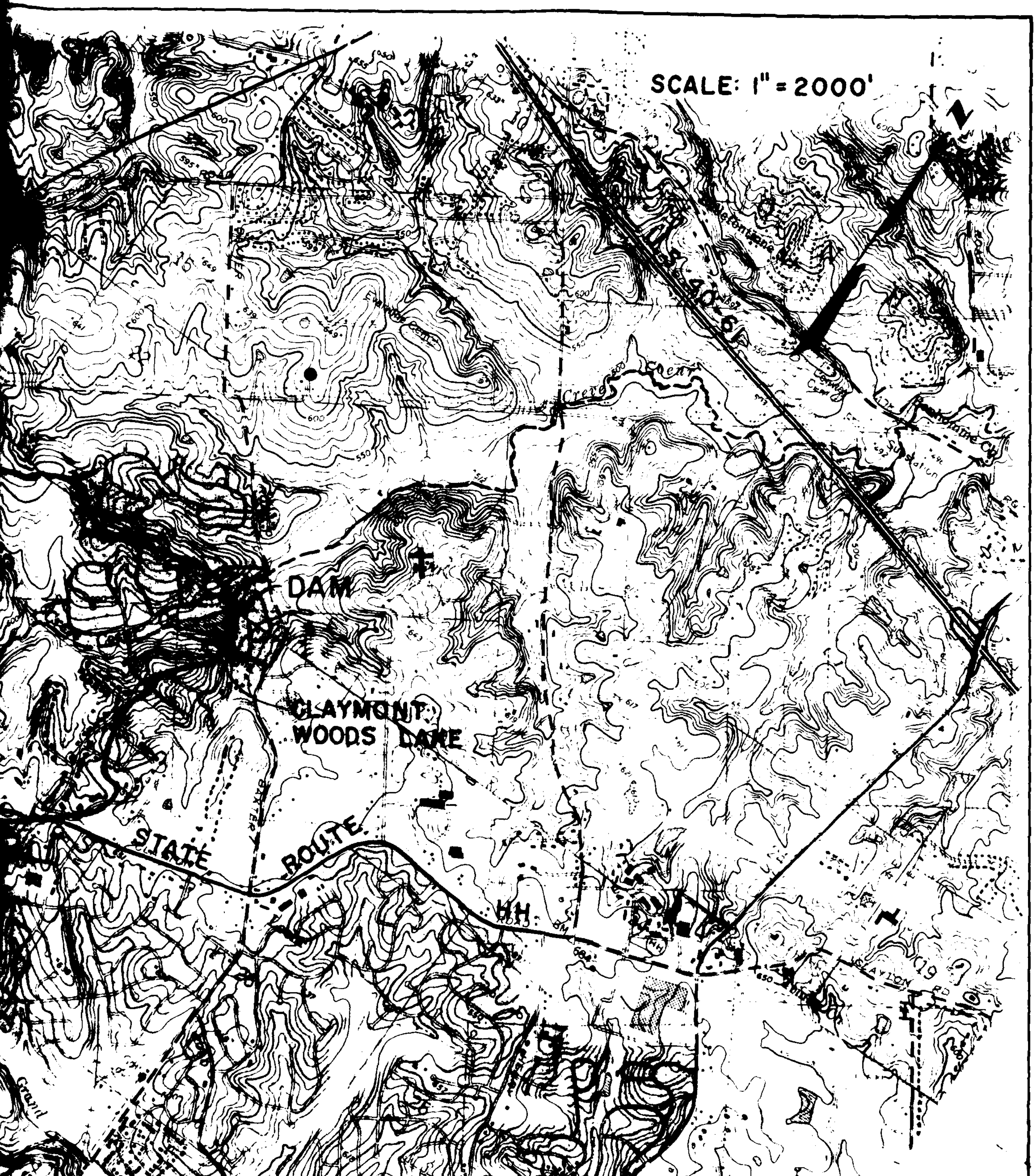
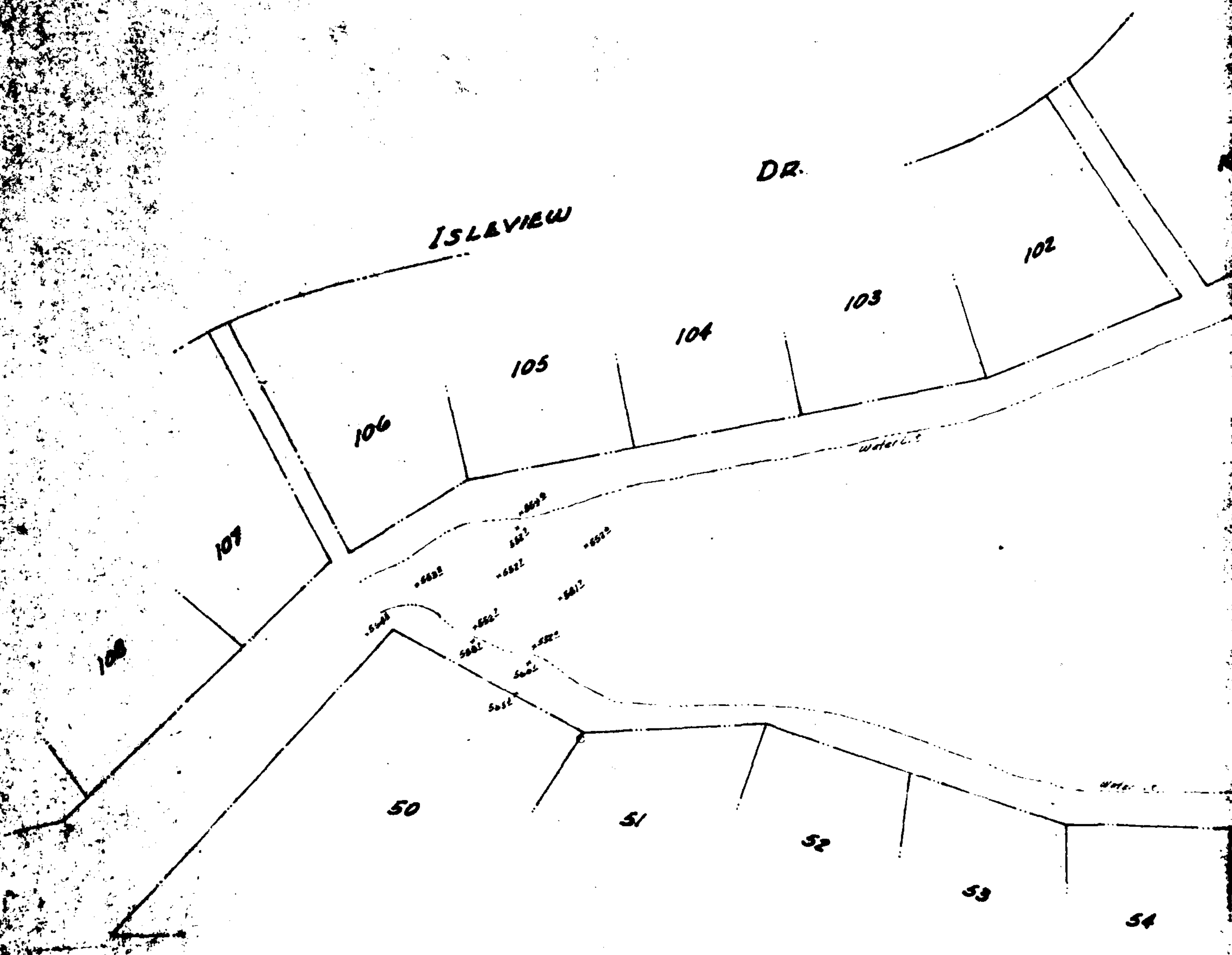
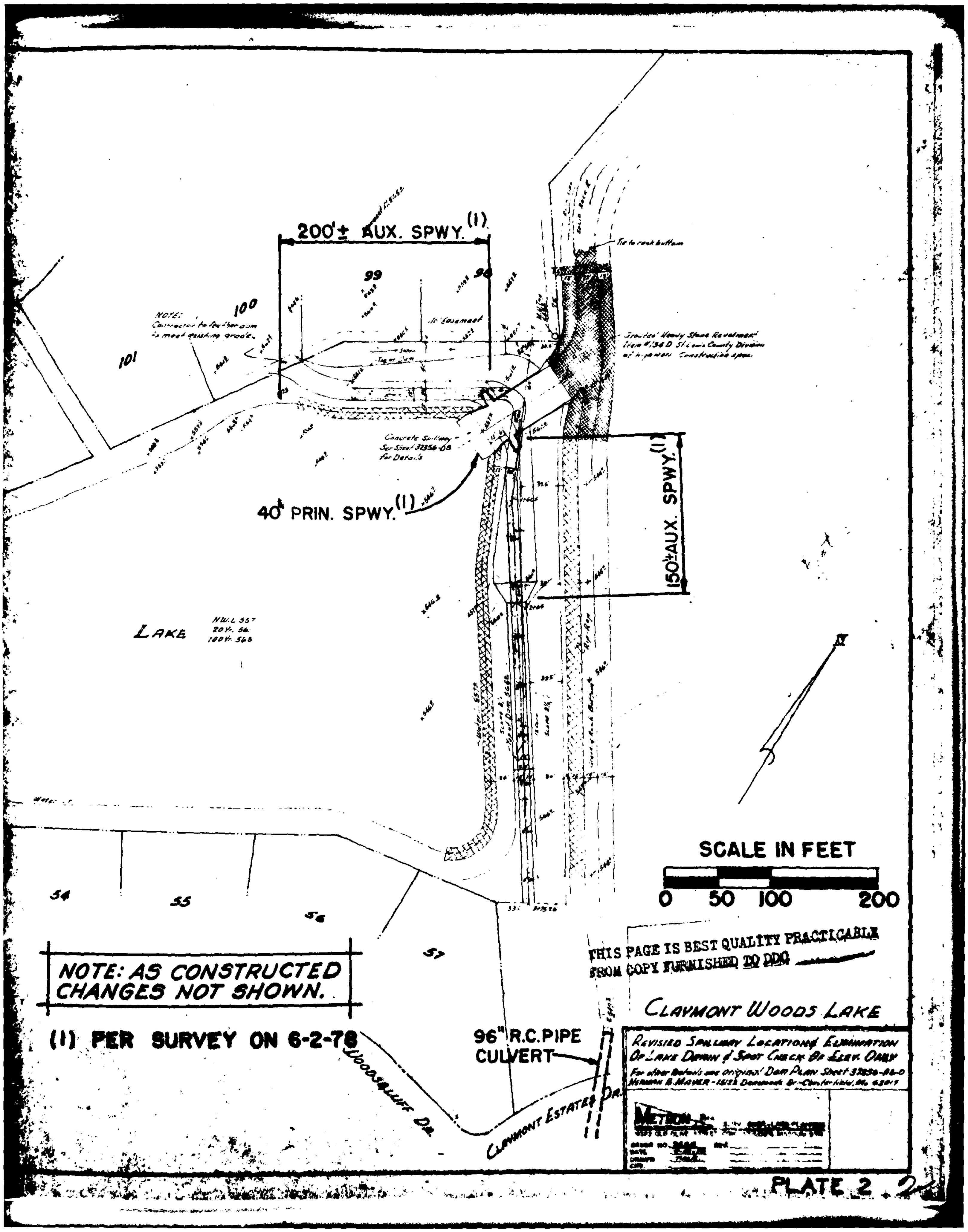

SCALE: 1" = 2000'
DAM
CLAYMONT WOODS LAKE
STATE ROUTE HH
REGIONAL VICINITY MAP

PLATE 1



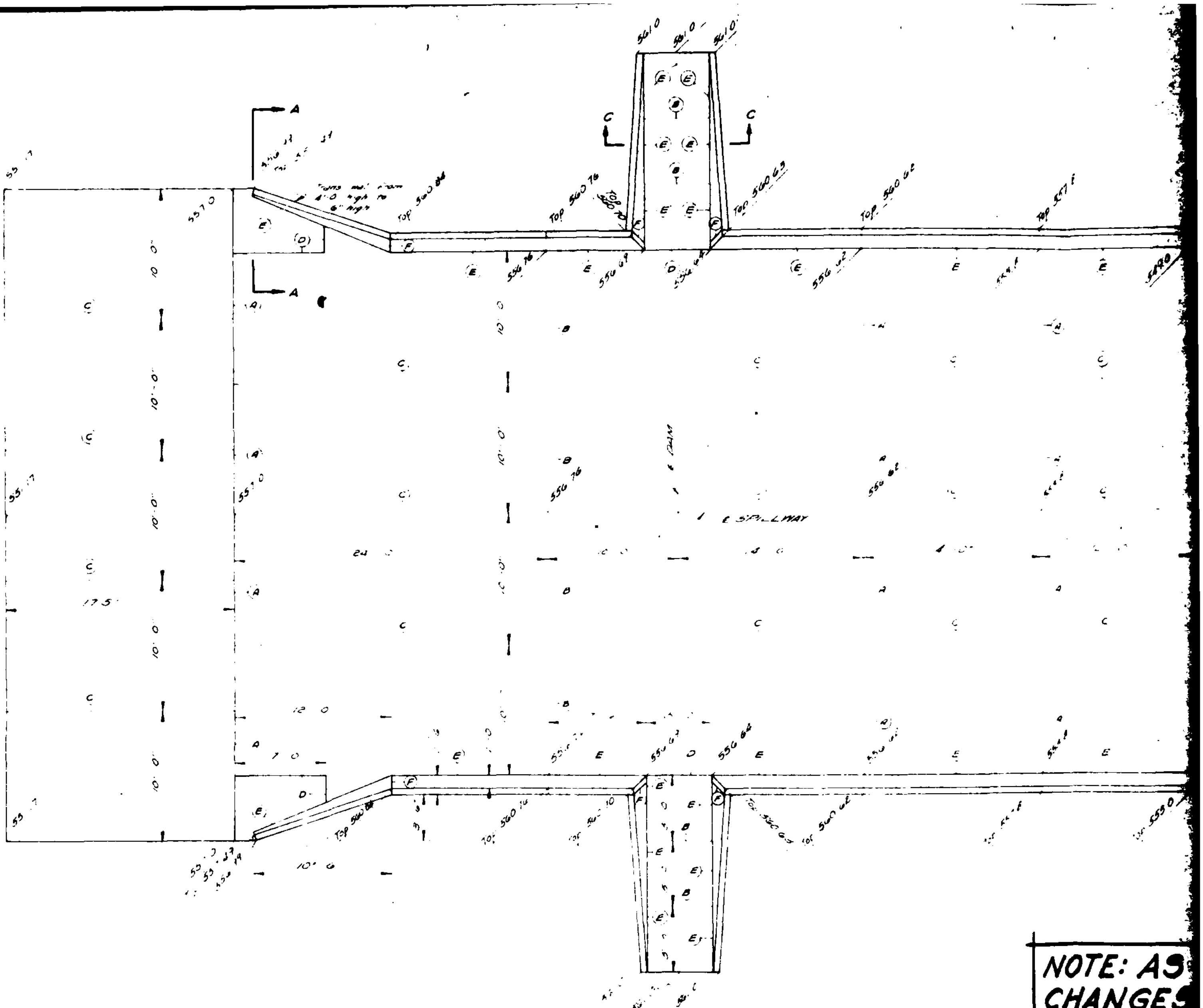
NOTES
CHAN

(1)



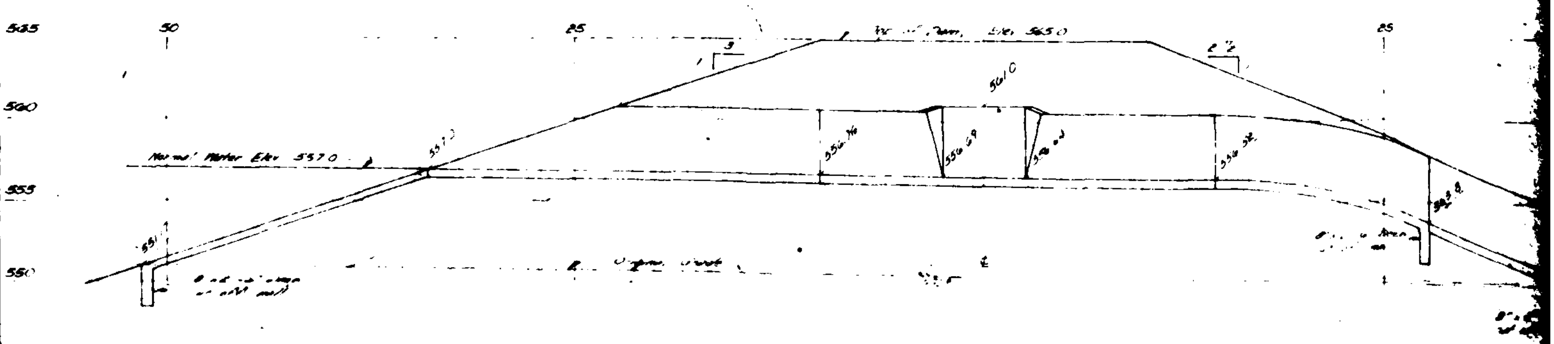
200'± AUX. SPWY.(1)
99
100
101
NOTE: Contractor to feather dam to meet existing grade.
Tie to rock bottom
Concrete Spillway See Sheet 31356-08 for Details
40'± PRIN. SPWY.(1)
150'± AUX. SPWY.(1)
LAKE
N.W.L. 557
SCALE IN FEET
0 50 100 200
54
55
56
57
NOTE: AS CONSTRUCTED CHANGES NOT SHOWN.
(1) PER SURVEY ON 6-2-78
96" R.C. PIPE CULVERT
WOODSBLUFF DR.
CLAYMONT ESTATES DR.
CLAYMONT WOODS LAKE
REVISED SPILLWAY LOCATION & ELIMINATION OF LAKE DRAIN & SPOT CHECK OF ELEV. ONLY

PLATE 2

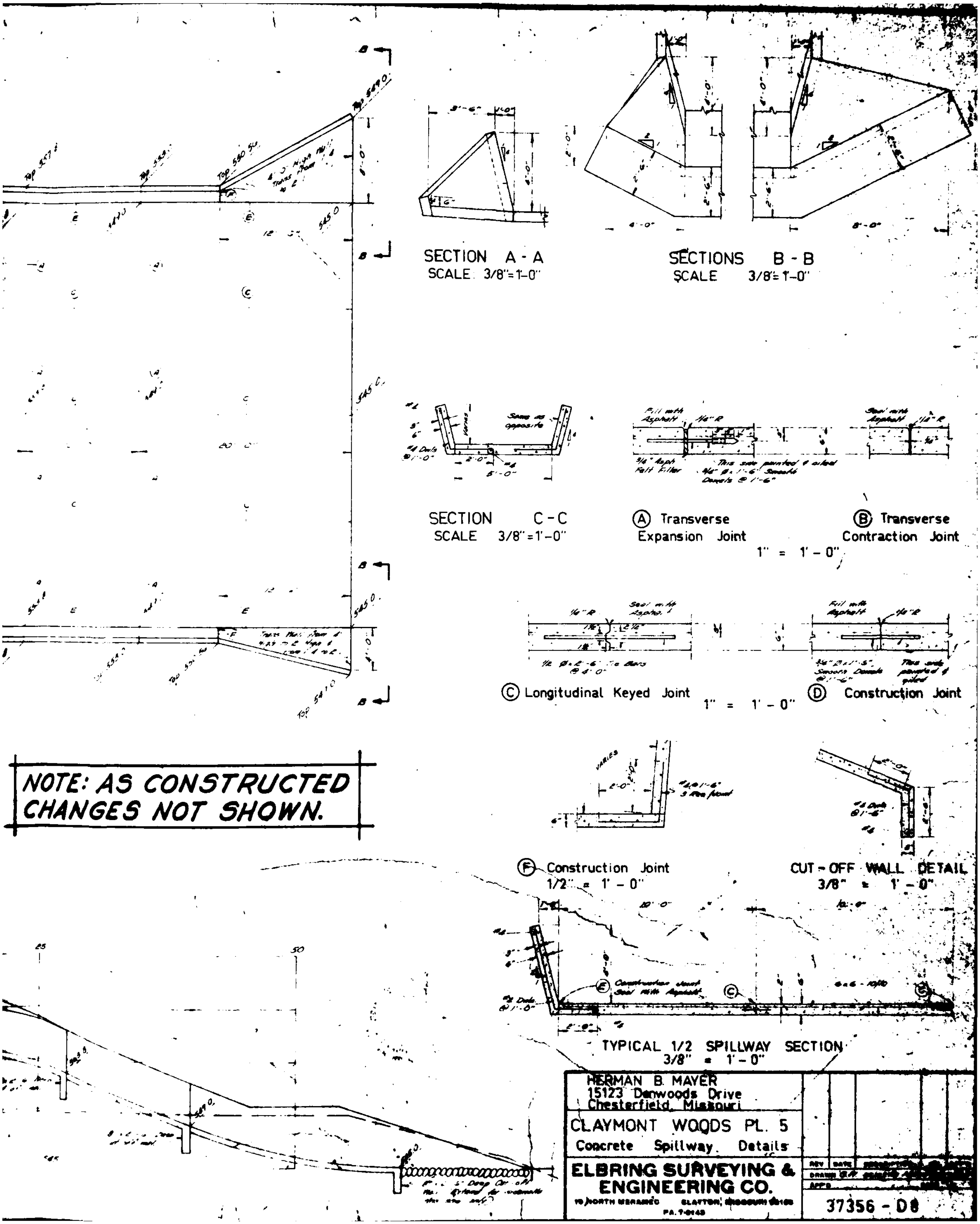


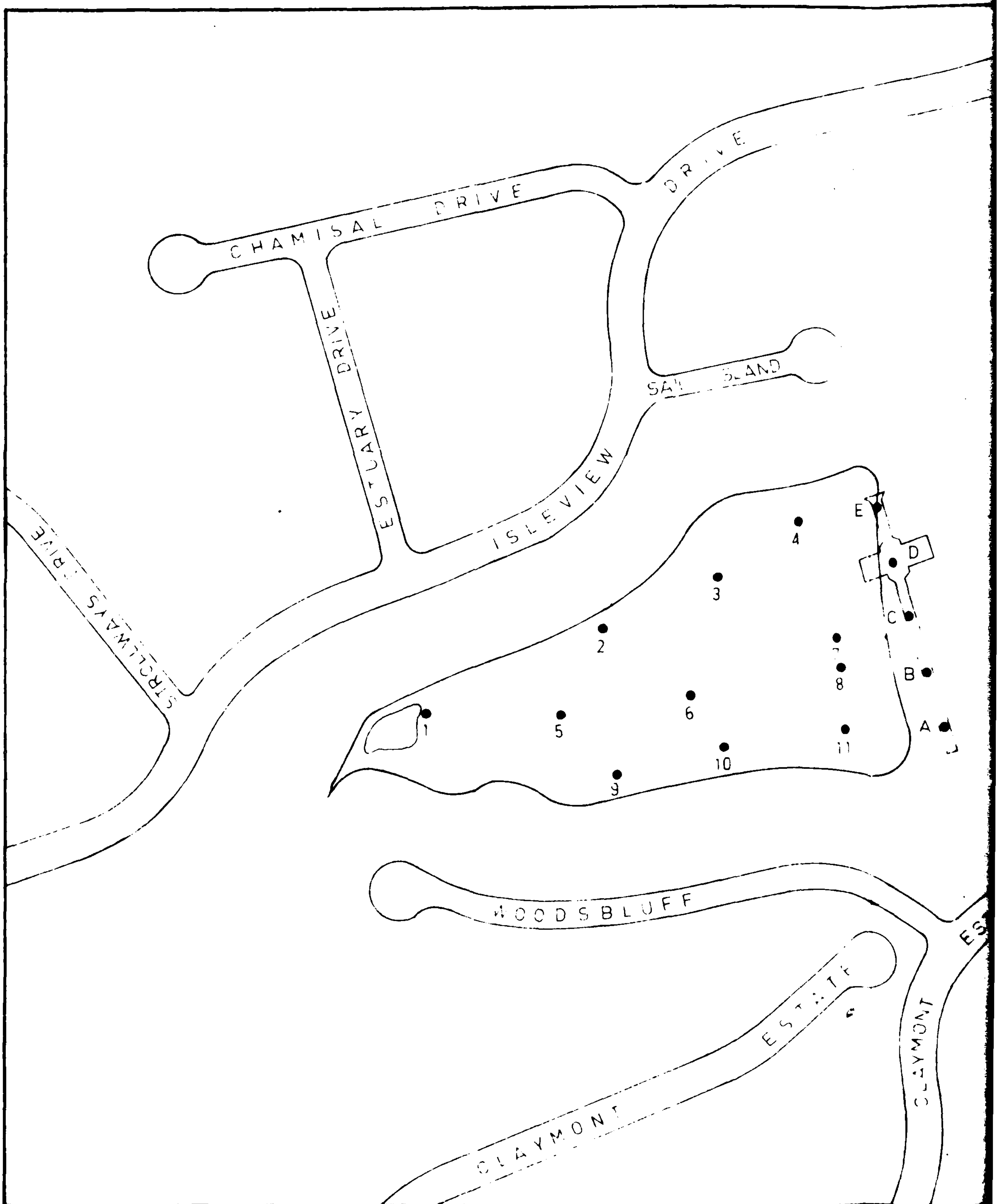
NOTE: AS
CHANGES

PLAN OF CONC. SPILLWAY
SCALE 1" = 5'



PROFILE OF CONC. SPILLWAY
SCALE 1" = 5'


SECTION A - A
SCALE 3/8"=1'-0"
SECTIONS B - B
SCALE 3/8"=1'-0"
SECTION C - C
SCALE 3/8"=1'-0"
(A) Transverse Expansion Joint
(B) Transverse Contraction Joint
1" = 1' - 0"
(C) Longitudinal Keyed Joint
1" = 1' - 0"
(D) Construction Joint
NOTE: AS CONSTRUCTED CHANGES NOT SHOWN.
(F) Construction Joint
1/2" = 1' - 0"
CUT - OFF WALL DETAIL
3/8" = 1' - 0"
TYPICAL 1/2 SPILLWAY SECTION
3/8" = 1' - 0"
HERMAN B. MAYER
15123 Denwoods Drive
Chesterfield, Missouri
CLAYMONT WOODS PL. 5
Concrete Spillway Details
ELBRING SURVEYING & ENGINEERING CO.
37356 - D8


CHAMISAL DRIVE
DRIVE
ESTUARY DRIVE
ISLEVIEW
STROLLWAYS
WOODSBLUFF
CLAYMONT ESTATE
CLAYMONT
E
D
C
B
A
1
2
3
4
5
6
8
9
10
11

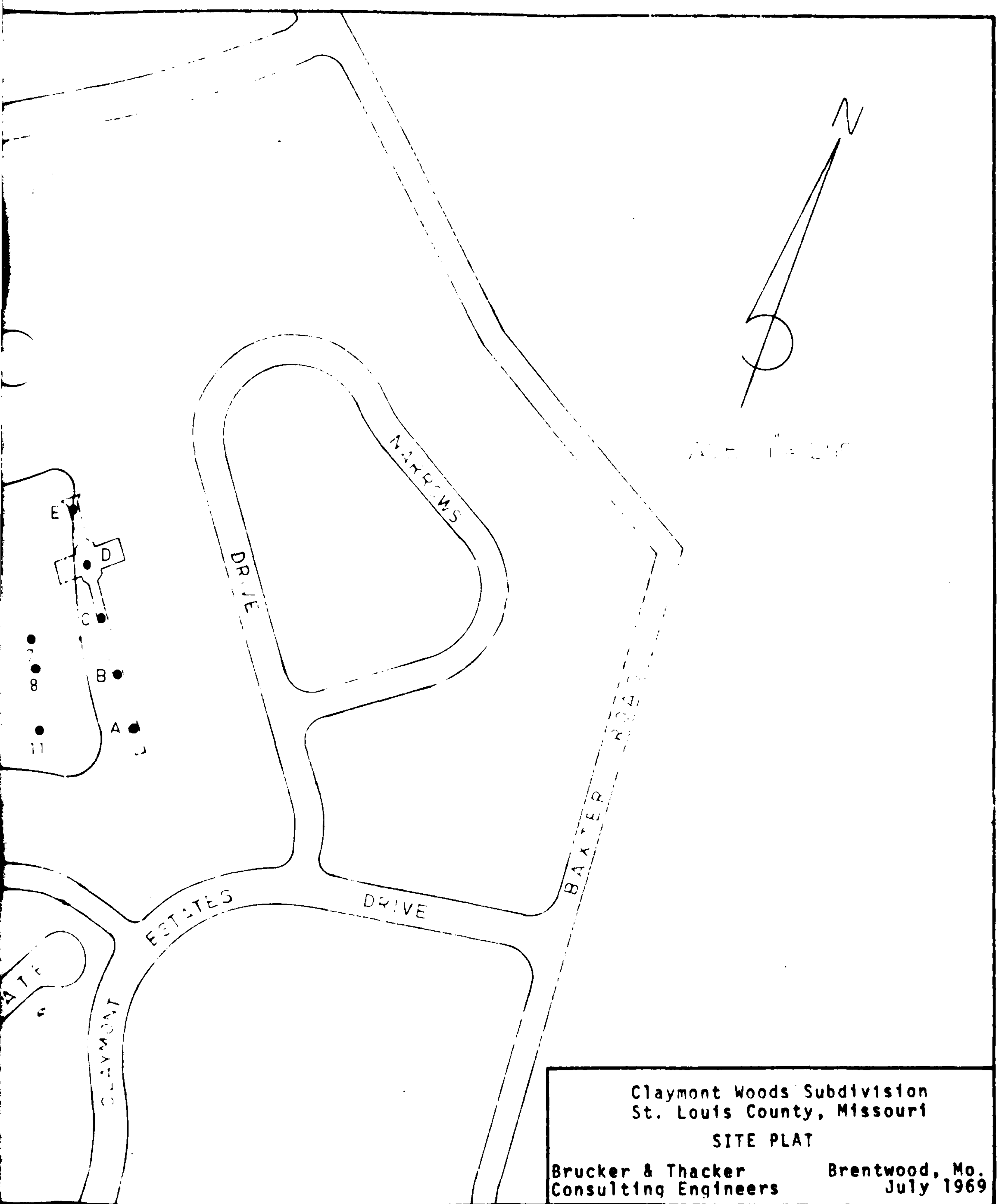
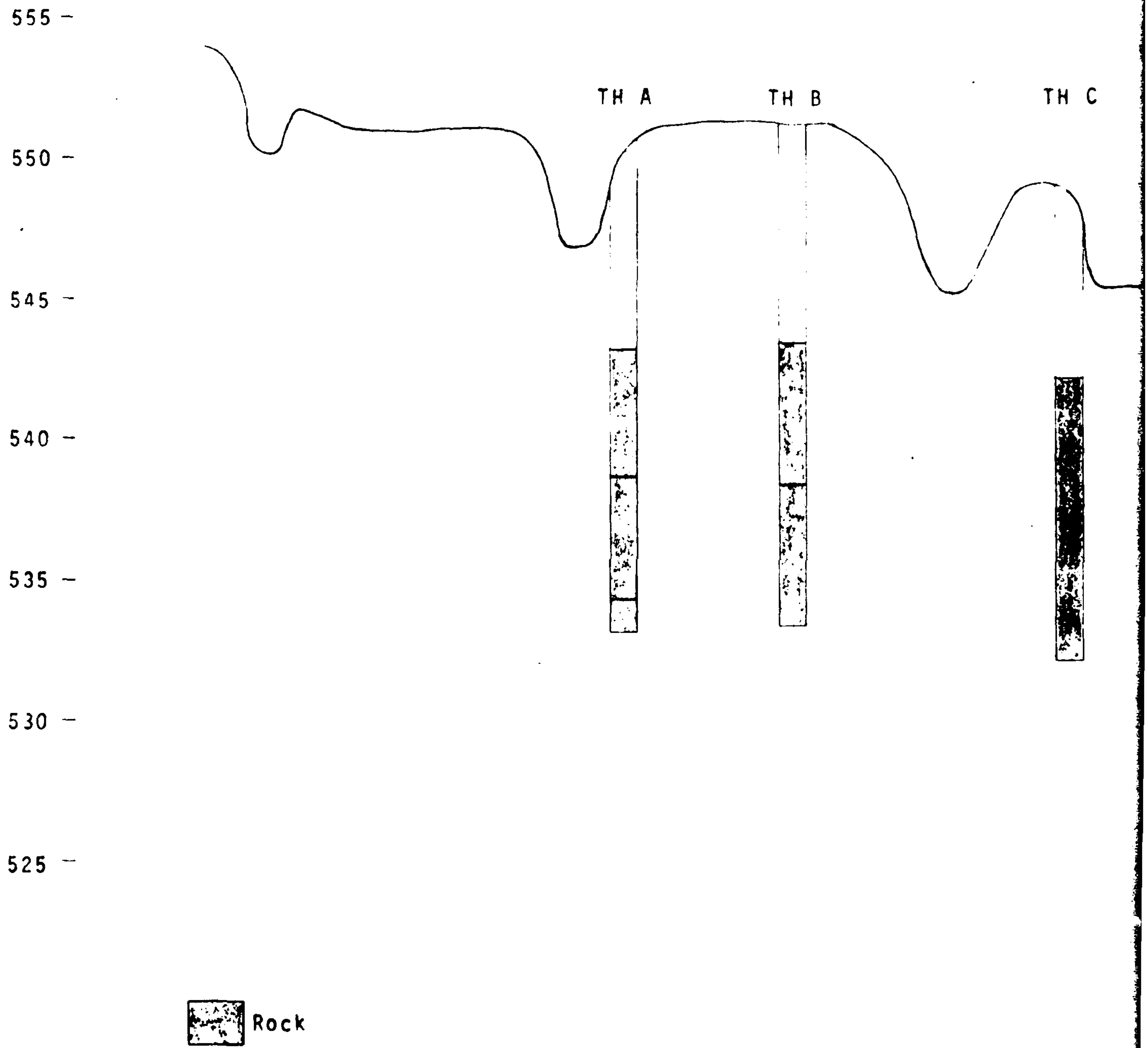
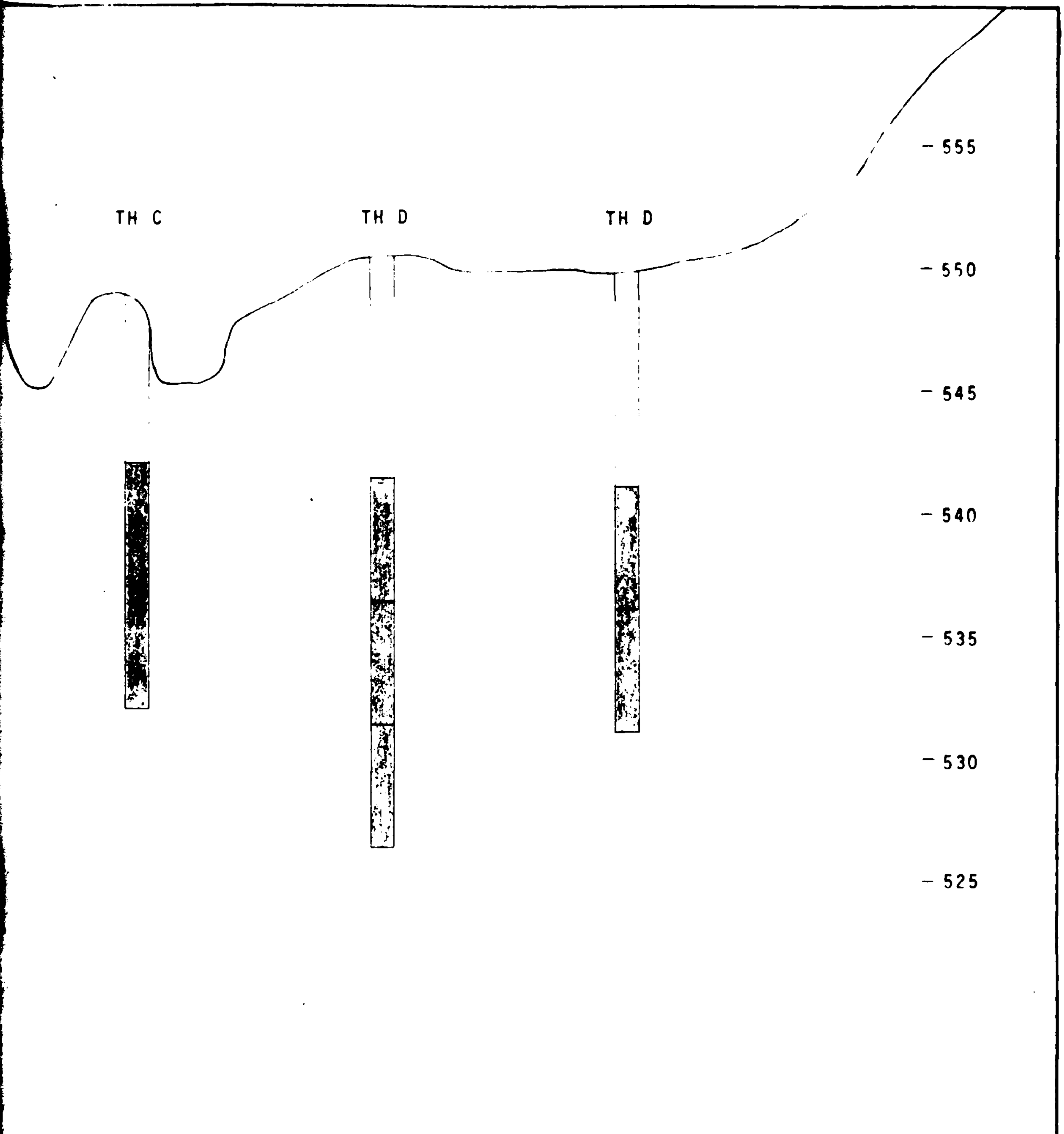

N
NARROWS
DRIVE
ESTATES
DRIVE
BAXTER
E
D
C
B
A
8
Claymont Woods Subdivision
St. Louis County, Missouri
SITE PLAT
Brucker & Thacker
Consulting Engineers
Brentwood, Mo.
July 1969

Plate 4



555
550
545
540
535
530
525
TH A
TH B
TH C
Rock



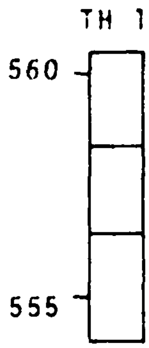
Claymont Woods Subdivision
St. Louis County, Missouri

SECTION ALONG AXIS OF DAM

Brucker & Thacker Brentwood, Mo.
Consulting Engineers July 1969

Plate 5

2



Dark brown silt with lignite and fine sand throughout.

Dark brown silty clay with small rock.

Light grey clay with limonite stains and lignite.

Refusal on rock or boulders.

Test holes 1 through 11 in the lake bottom drilled 5/26/69.

Claymont Woods Subdivision
Chesterfield, Missouri

BORING LOG

Brucker & Thacker
Consulting Engineers

Brentwood, Mo.
July 1969

TH 2

Grey silt with lignite and limonite stains.

555

Brown and grey clayey silt with lignite and limonite stains on rock.

Refusal on rock or boulders.

550

TH 3

555

Light grey clayey silt w and limonite with fine s throughout.

Brown and grey silty cl lignite, limonite stain sand throughout and rocl at depth.

550

545

Refusal on rock or boul

y clayey silt with lignite
ite with fine sand
.

grey silty clay with
limonite stains and fine
ughout and rock fragments

n rock or boulders.

555 TH 4

Brown with grey silt with
limonite stains, lignite.

Brown with grey clayey silt
with limonite and lignite.

550

Brown clayey silt with lignite
and small rock fragments.

Refusal on rock or boulders.

545

Claymont Woods Subdivision
Chesterfield, Missouri

BORING LOGS

Brucker & Thacker Consulting Engineers

Brentwood, Mo.
July 1969

TH 5

Dark brown clayey silt with lignite and gravel.

555 –

Brown with tan silt with lignite.

Refusal on rock or boulders.

550 –

TH 6

Dark brown silt with lign
and fine sand throughout.

555 –

Dark brown clayey silt wi
lignite and small rocks.

Refusal on rock or boulde

550 –

own silt with lignite
e sand throughout.

own clayey silt with
and small rocks.

on rock or boulders

TH 7

550 — Brown with grey silt with lignite and trace of fine sand.

Brown silty clay with lignite and limonite stains and rock fragments.

545 —

Refusal on rock or boulders.

Claymont Woods Subdivision
Chesterfield, Missouri

BORING LOGS

Brucker & Thacker	Brentwood, Mo.
Consulting Engineers	July 1969

550 —

TH 9

Greyish brown very silty clay with limonite, lignite, and fine sand.

545 —

Refusal on rock or boulders.

Claymont Woods Subdivision
Chesterfield, Missouri

BORING LOG

Brucker & Thacker Consulting Engineers

Brentwood, Mo.
July 1969

TH 9

550 —

Yellow brown clayey sand
and gravel.

Refusal on rock or boulders.

545 —

TH 10

550 —

Brown and grey clayey silt
lignite, limonite stains a
sand.

Grey clayey silt with lign
limonite stains and rock f

Yellow grey clay with lign
limonite stains.

545 —

Refusal on rock or boulder

540 —

grey clayey silt with
limonite stains and fine

ey silt with lignite,
stains and rock fragments.

ey clay with lignite and
stains.

n rock or boulders.

TH 11

550 —

545 —

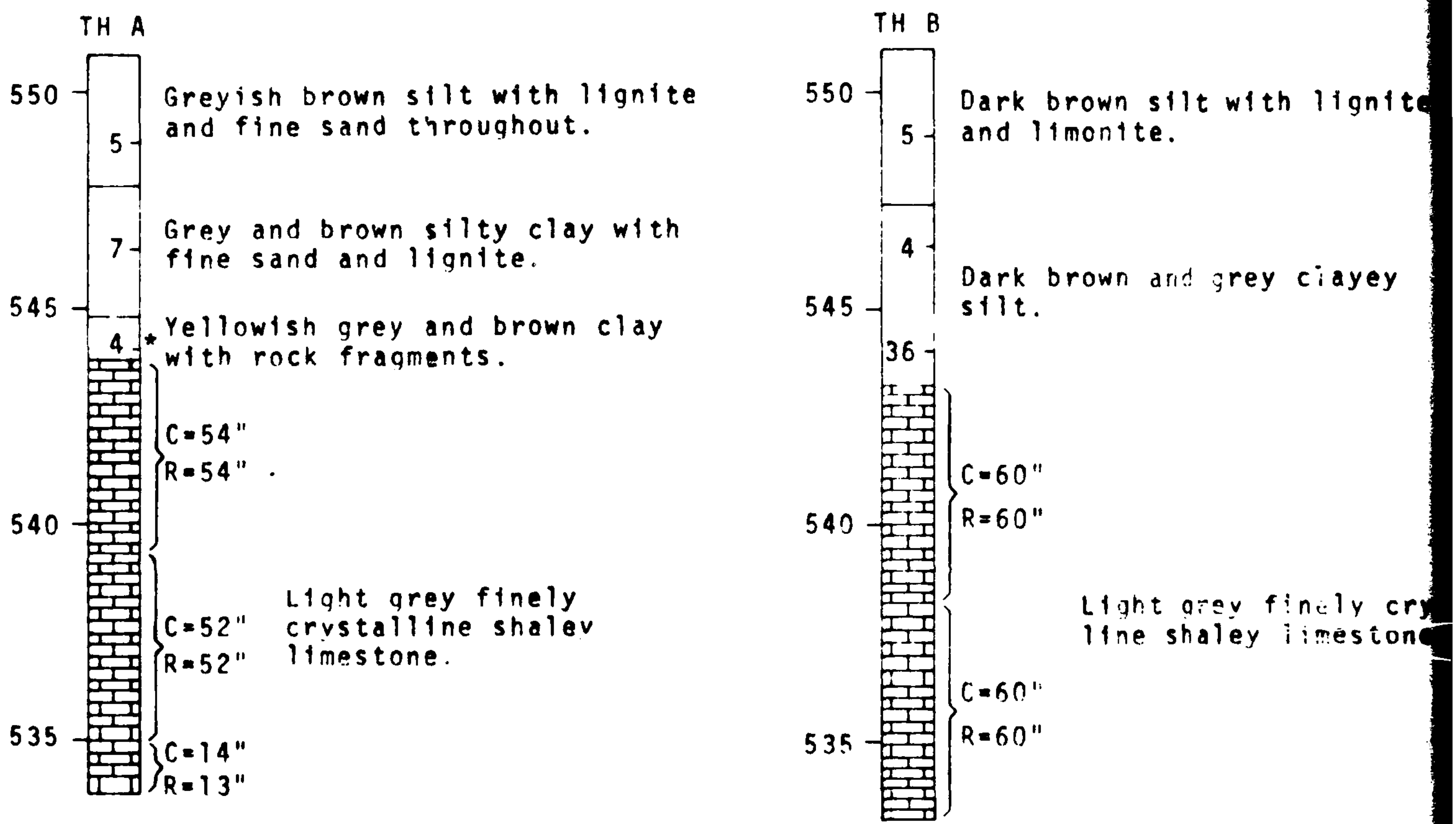
Yellow brown and grey silty clay
with lignite and limonite and
fine sand throughout.

Refusal on rock or boulders.

Claymont Woods Subdivision
Chesterfield, Missouri

BORING LOGS

Brucker & Thacker Brentwood, Mo.
Consulting Engineers July 1969



*Blows per 6 inches.

No water loss.

No water loss.

Test holes "A" through "E" along centerline of Dam drilled 6/13-24/69.

C = inches of rock cored.
R = inches of rock recovered.

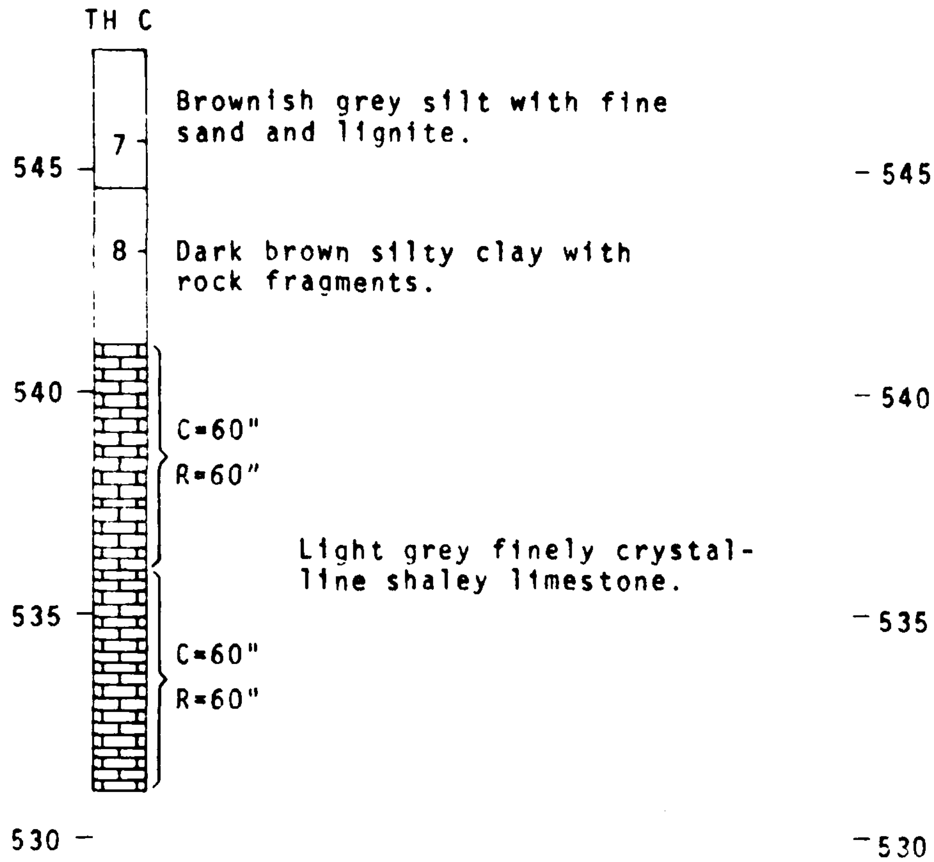
Figures within the graphical logs indicate the number of blows required to drive a 2-inch O.D. standard sampling spoon 12 inches, using a 140-pound weight falling 30 inches.

silt with lignite
te.

and grey clayey

ght grey finely crystal-
ne shaley limestone

oss

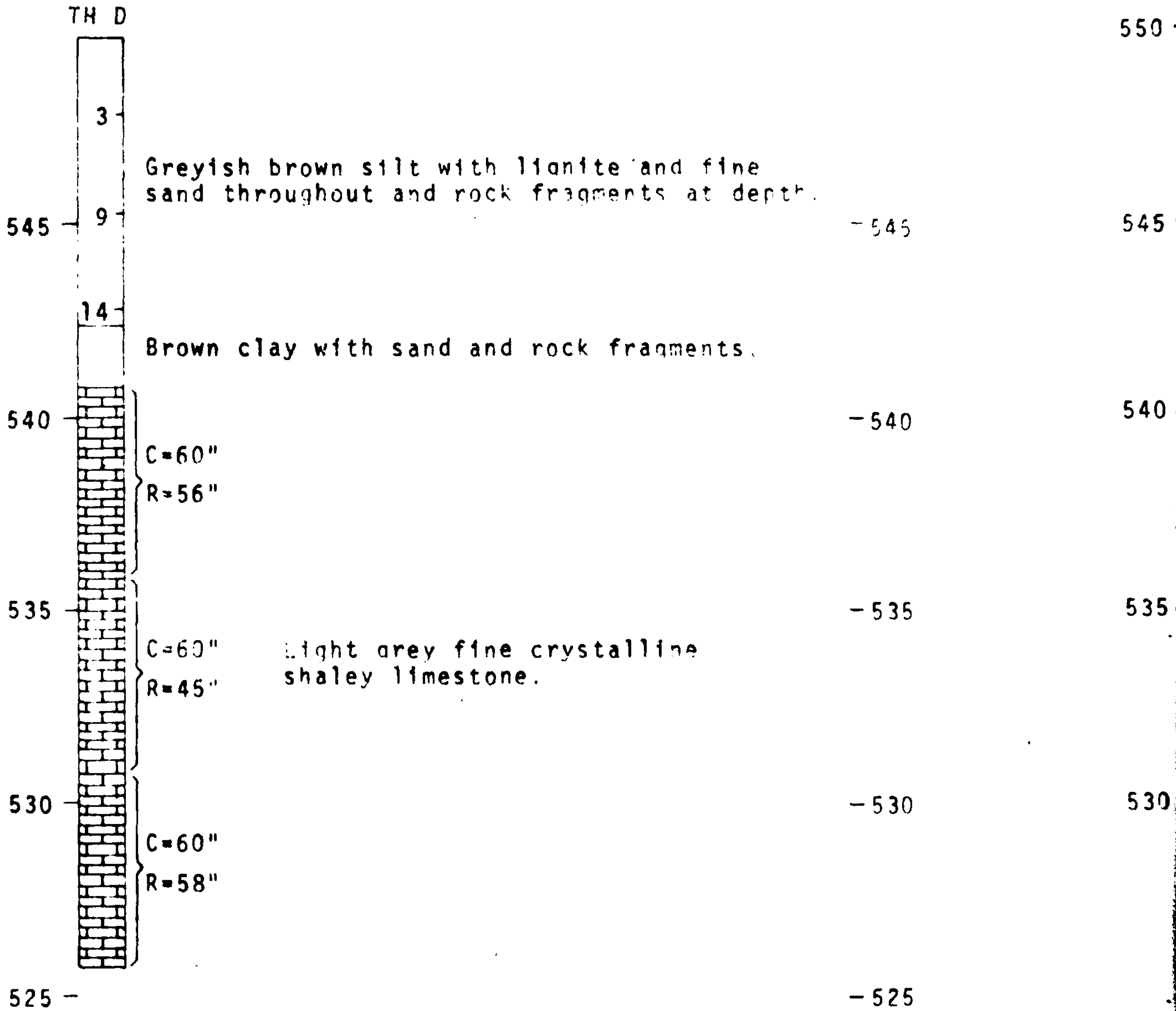


Claymont Woods Subdivision
Chesterfield, Missouri

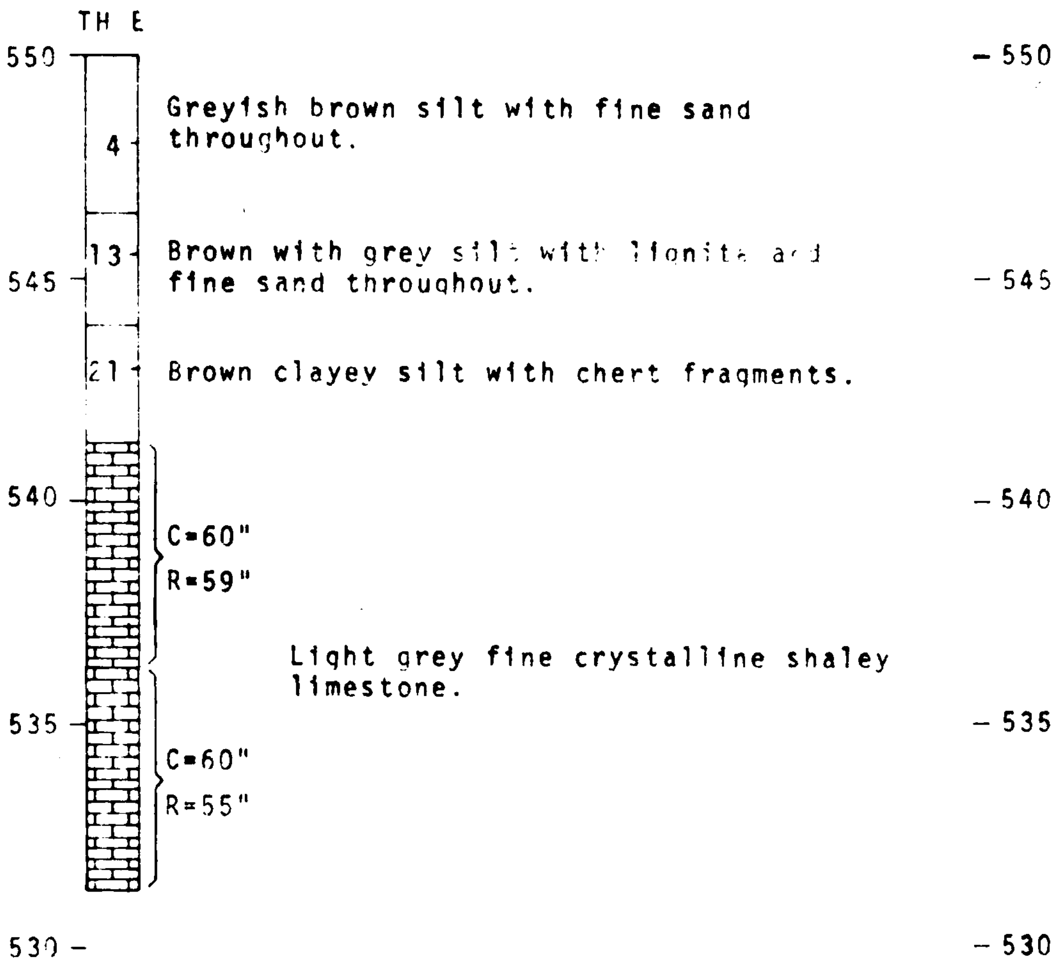
BORING LOGS

Brucker & Thacker Consulting Engineers

Brentwood, Mo.
July 1969



3" shale seam at 10'3".
Lost 75% of water at 16'9".
Lost 50% of water at 19'-24'.



Greyish brown silt with fine sand throughout.

Brown with grey silt with lignite and fine sand throughout.

Brown clayey silt with chert fragments.

Light grey fine crystalline shaley limestone.

2" shale seam at 16'5".
Lost all water at 16'5'.

Claymont Woods Subdivision
Chesterfield, Missouri

BORING LOGS

Brucker & Thacker Consulting Engineers

Brentwood, Mo.
July 1969

TH 22

Brown with grey clayey silt with lignite, limonite stains and fine sand becoming more clayey at depth.

630 –

Brown with grey slightly clayey silt with lignite and limonite stains.

625 –

Yellowish brown silty clay with limonite and lignite.

620 –

Yellow brown clay with limonite stains, lignite and rock fragments.

Yellow brown and grey silty clay with limonite and lignite.

615 –

Yellowish brown clay with lignite and limonite stains.

610 –

No refusal.

TH 23

625 –

Brown with grey clayey silt with lignite and limonite stains and trace of fine sand throughout.

620 –

Brown and grey silt with lignite and fine sand.

Brown clayey silt with lignite and limonite stains with fine sand throughout.

615 –

Yellow brown and grey clay with lignite, limonite stains and rock fragments at depth.

610 –

605 –

Yellow brown slightly sandy clay with lignite.

No refusal.

th grey clayey
h lignite and
stains and trace
sand throughout.

d grey silt with
and fine sand.

ayey silt with
and limonite
ith fine sand
ut.

rown and grey
h lignite,
stains and rock
at depth.

rown slightly
ay w lignite.

al.

Th 24

625 — Brown with grey clayey silt with lignite and limonite stains and trace of fine sand.

620 — Brown slightly clayey silt with lignite.

615 — Yellowish brown slightly silty clay with lignite and small gravel at depth.

610 — Yellow brown clay with lignite and rock fragments at depth.

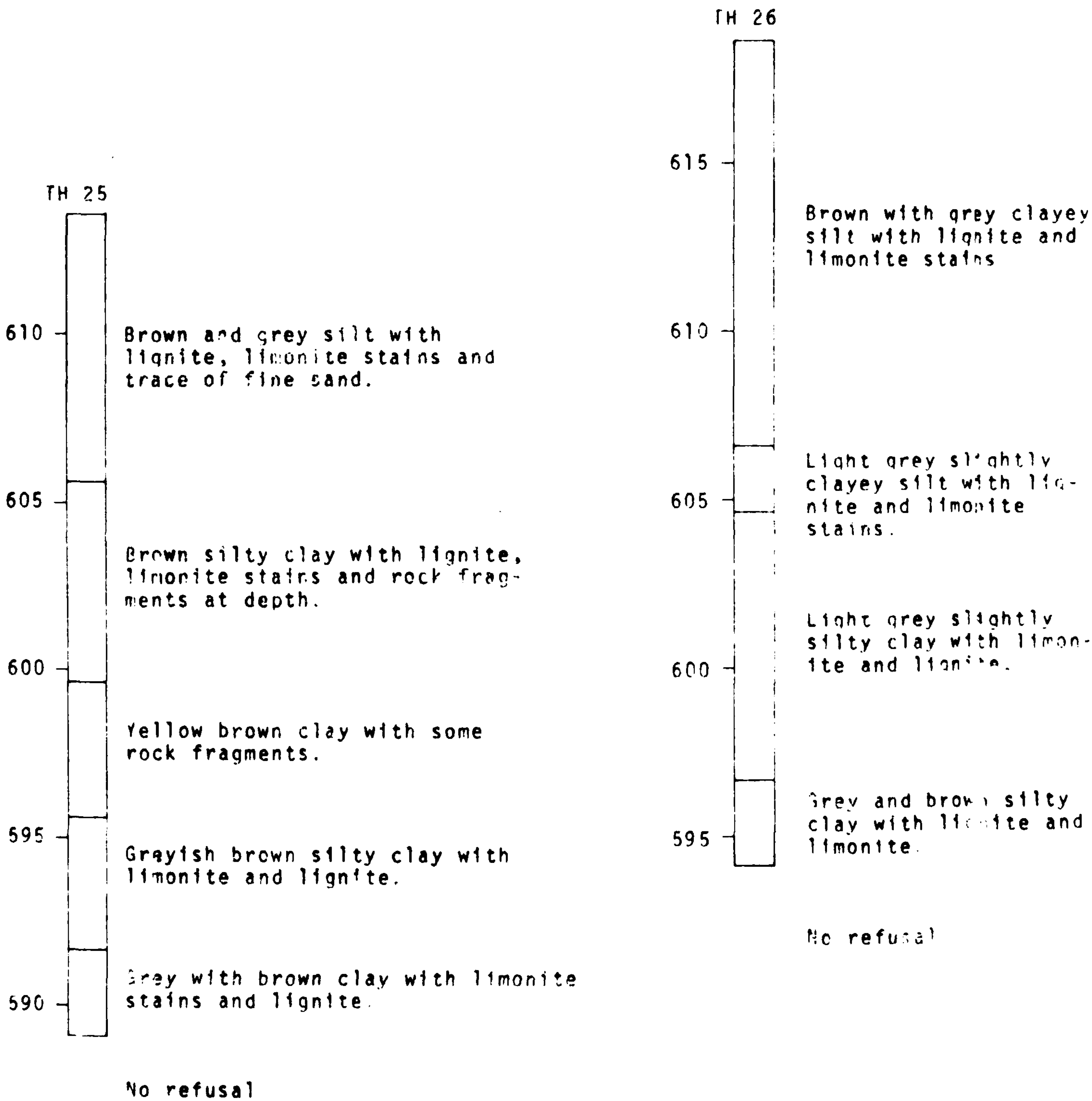
605 —

No refusal.

Claymont Woods Subdivision
Chesterfield, Missouri

BORING LOGS

Brucker & Thacker Consulting Engineers — Brentwood, Mo. — July 1969


TH 25
610
605
600
595
590
Brown and grey silt with lignite, limonite stains and trace of fine sand.
Brown silty clay with lignite, limonite stains and rock fragments at depth.
Yellow brown clay with some rock fragments.
Grayish brown silty clay with limonite and lignite.
Grey with brown clay with limonite stains and lignite.
No refusal
TH 26
615
610
605
600
595
Brown with grey clayey silt with lignite and limonite stains
Light grey slightly clayey silt with lignite and limonite stains.
Light grey slightly silty clay with limonite and lignite.
Grey and brown silty clay with lignite and limonite.
No refusal

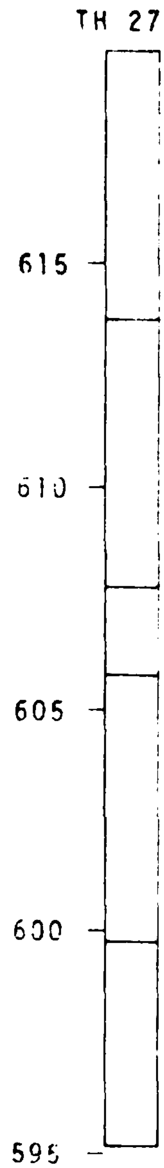
th grey clayey
h lignite and
stains

ey slightly
ilt with lig-
limonite

ey slightly
ay with limon-
lignite.

brow silty
h lignite and

al.



Brown and grey clayey silt with lignite, limonite stains, and trace of fine sand

Light brown and grey clayey silt with lignite and fine sand becoming more clayey with depth

Orange brown clay with lignite and limonite stains.

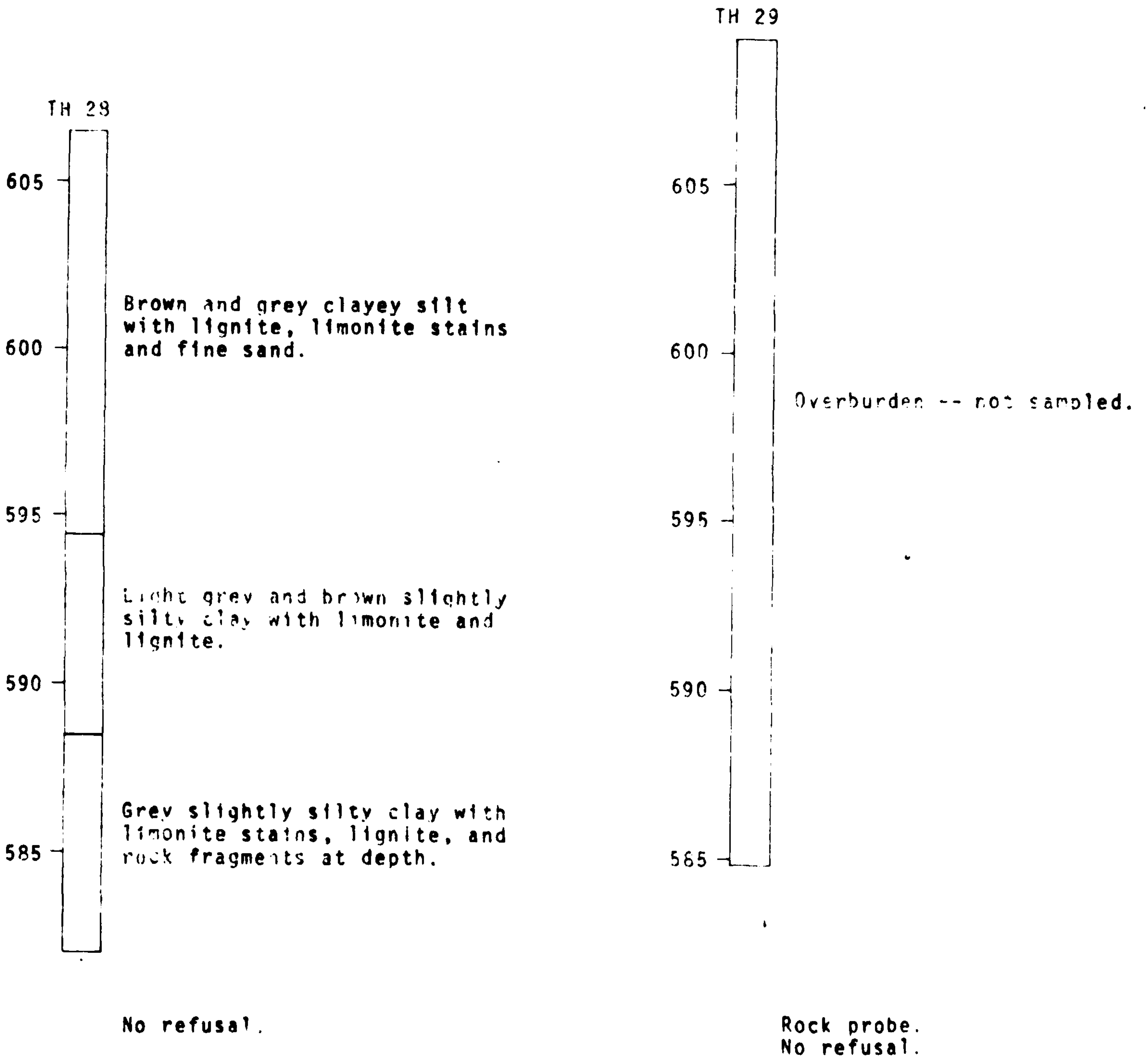
Yellowish brown clayey silt with limonite stains and fine sand throughout

Grey and yellow brown silty clay with lignite and fine sand throughout.

No refusal.

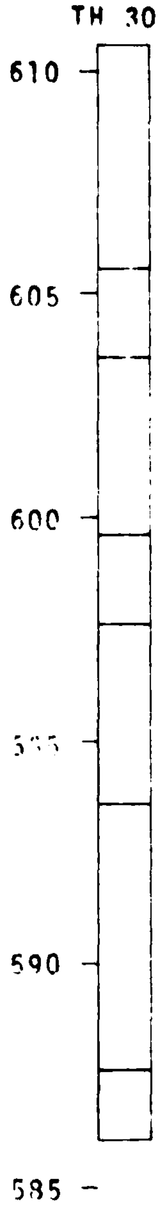
Claymont Woods Subdivision Chesterfield, Missouri BORING LOGS	
Brucker & Thacker Consulting Engineers	Brentwood, Mo. July 1969

PLATE 14



TH 28
605
600
595
590
585
Brown and grey clayey silt with lignite, limonite stains and fine sand.
Light grey and brown slightly silty clay with limonite and lignite.
Grey slightly silty clay with limonite stains, lignite, and rock fragments at depth.
No refusal.
TH 29
605
600
595
590
565
Overburden -- not sampled.
Rock probe.
No refusal.

n -- not sampled.



Brown and grey clayey silt with lignite and trace of fine sand.

Grey and brown slightly clayey silt with lignite and trace of fine sand throughout.

Brown and grey clayey silt with lignite and fine sand becoming more clayey with depth.

Orange brown clay.

Yellow brown silty clay with lignite and trace of fine sand.

Brown and grey silty clay with limonite stains, lignite, and trace of fine sand.

Yellow brown and grey sandy clay with lignite, limonite stains, and small gravel.

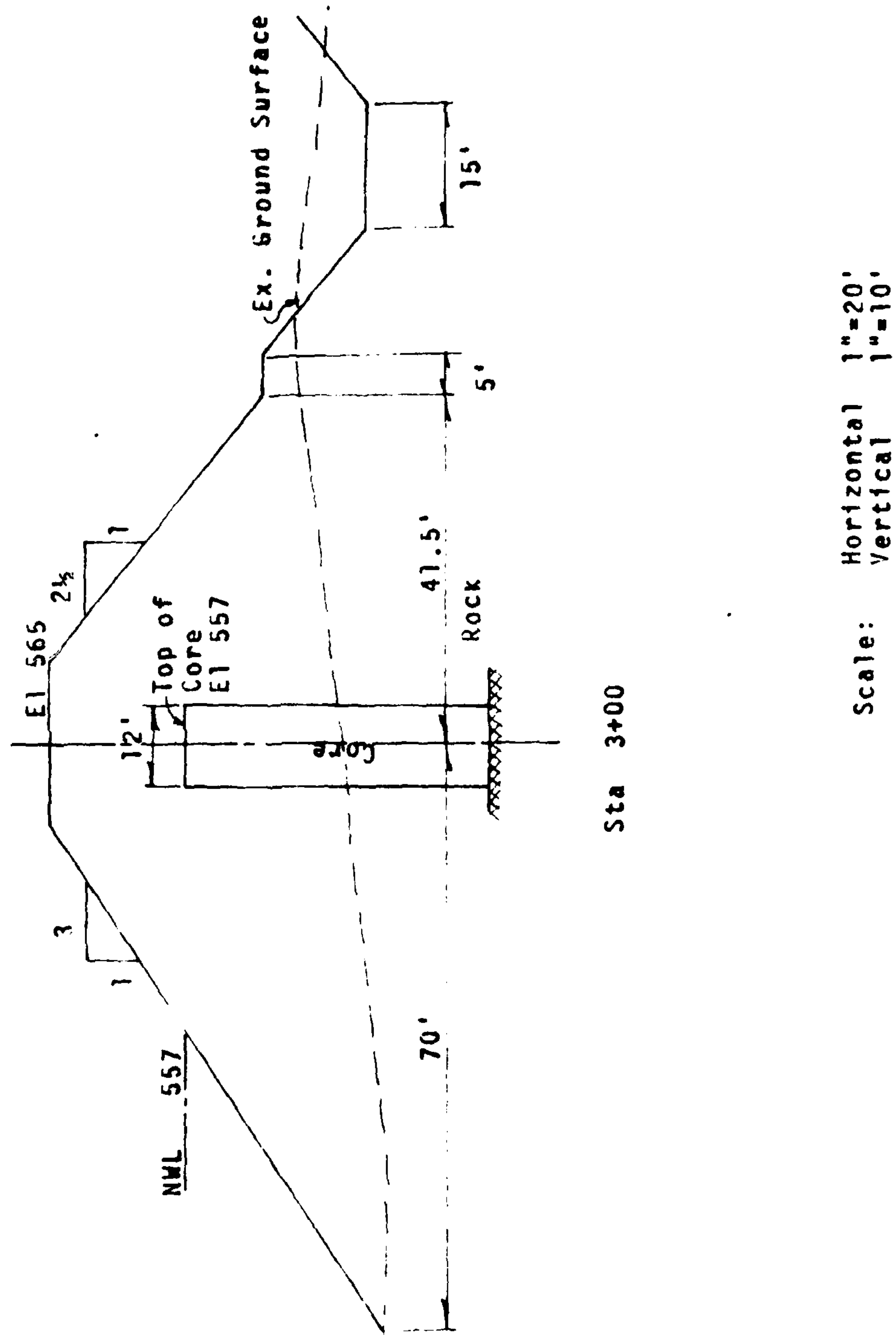
Rig limit no refusal.

Claymont Woods Subdivision
Chesterfield, Missouri

BORING LOGS

Brucker & Thacker Consulting Engineers — Brentwood, Mo. July 1969

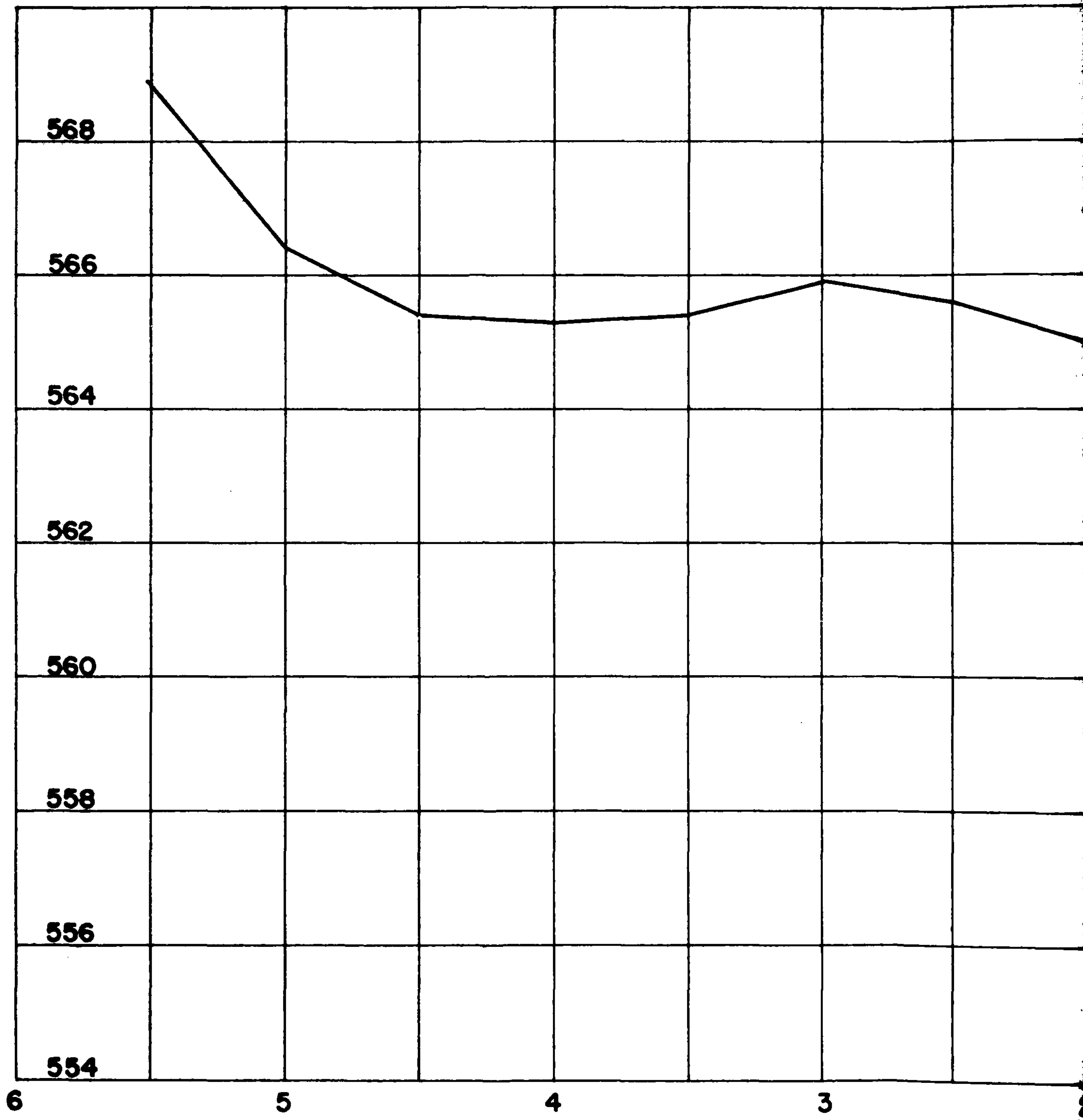
PLATE 15



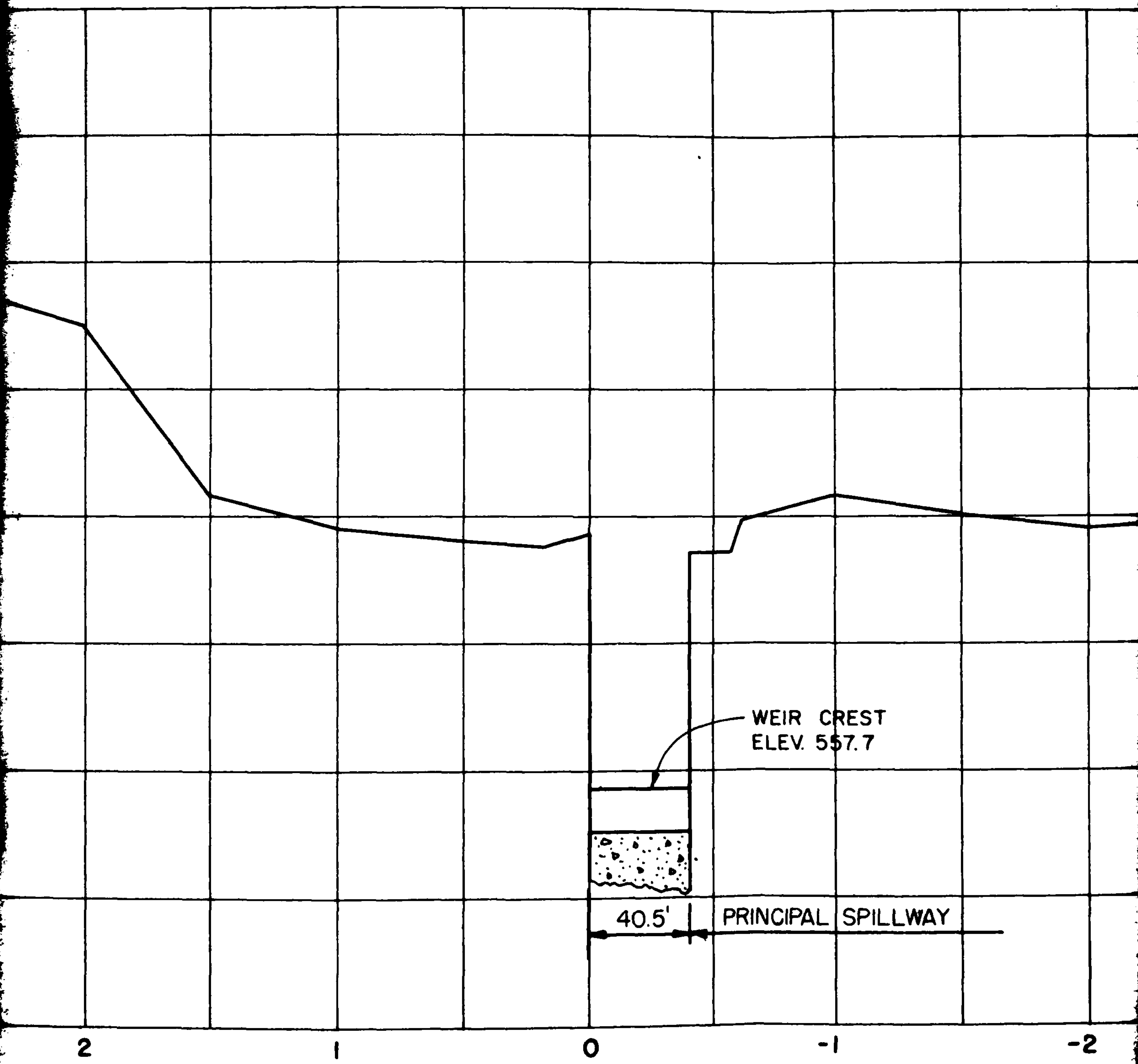
Claymont Woods Subdivision
St. Louis County, Missouri

CROSS SECTION OF DAM

Brucker & Thacker Consulting Engineers	Brentwood, Mo. September 1969



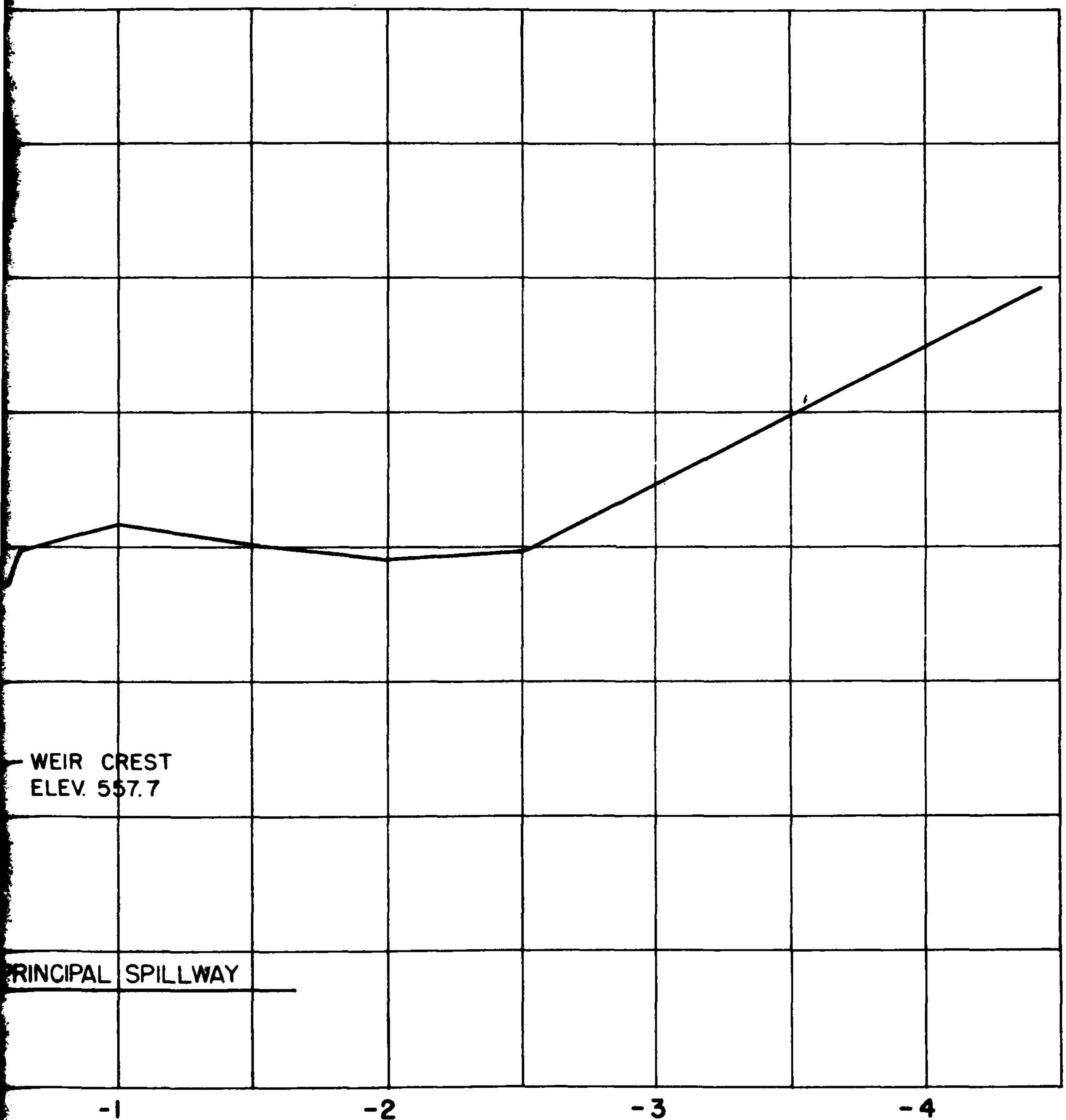
568
566
564
562
560
558
556
554
6
5
4
3



DAM PROFILE

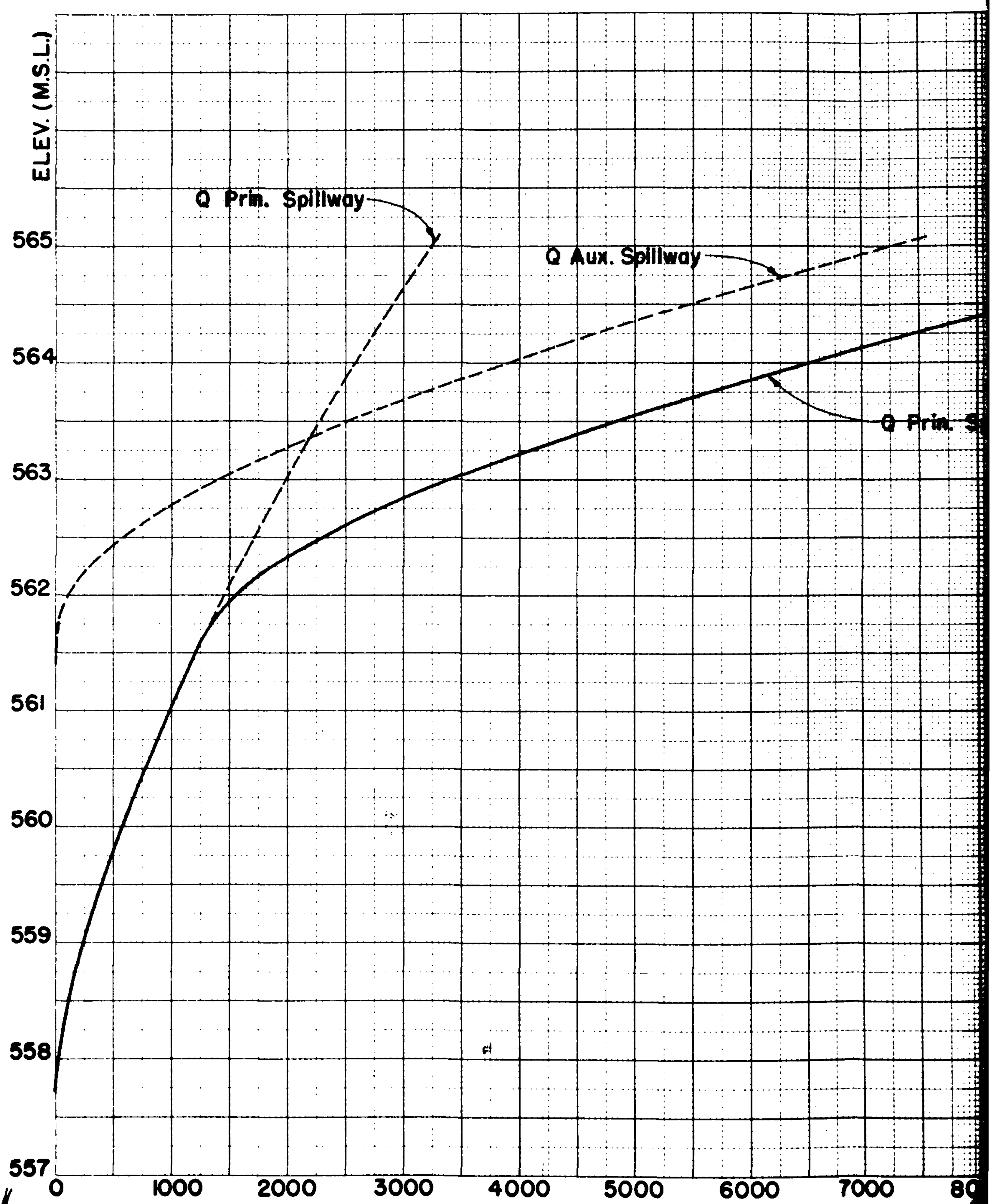
SCALES: 1" = 2' V., 1" = 50' H.

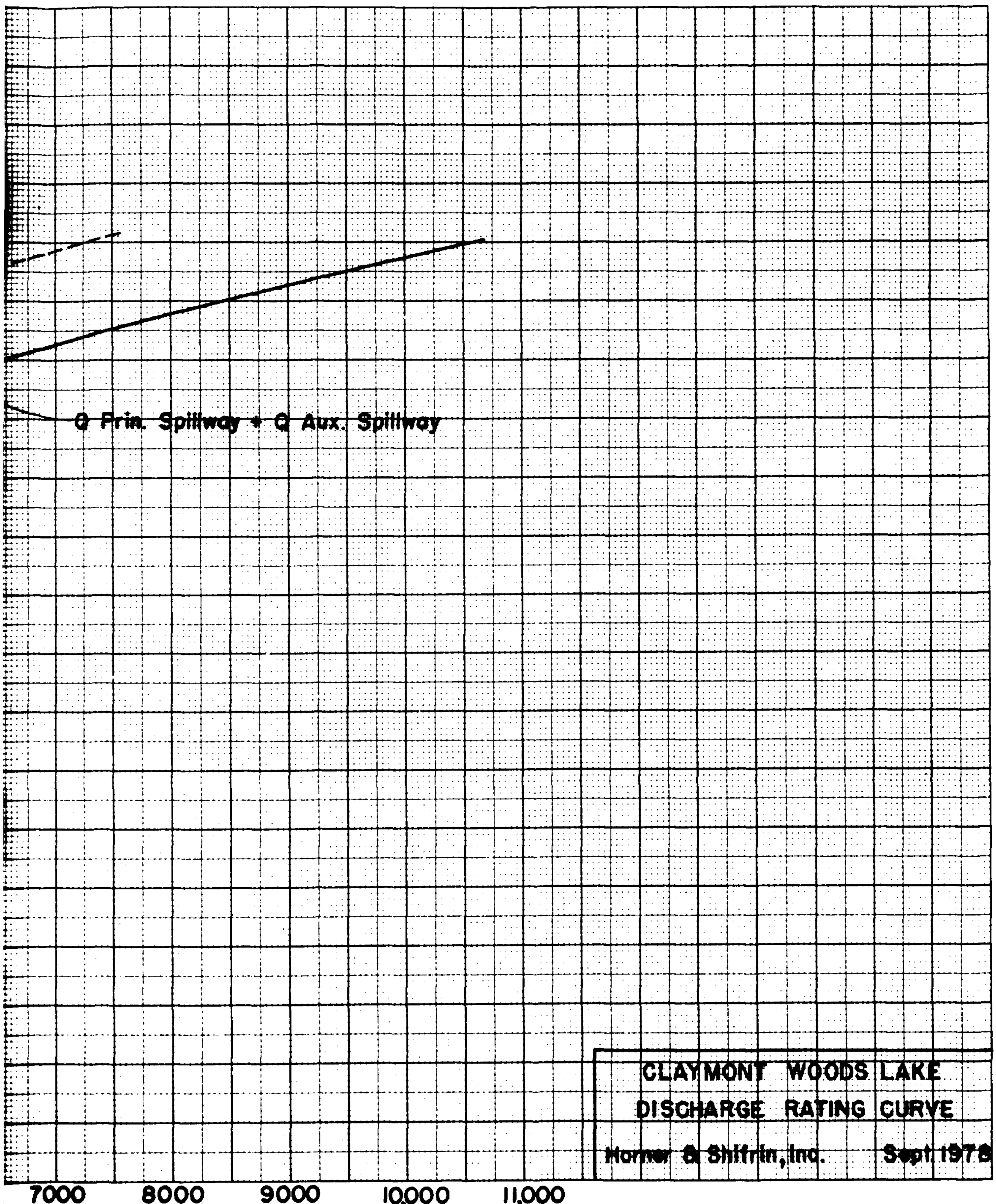
2



CLAYMONT WOODS LAKE
DAM PROFILE

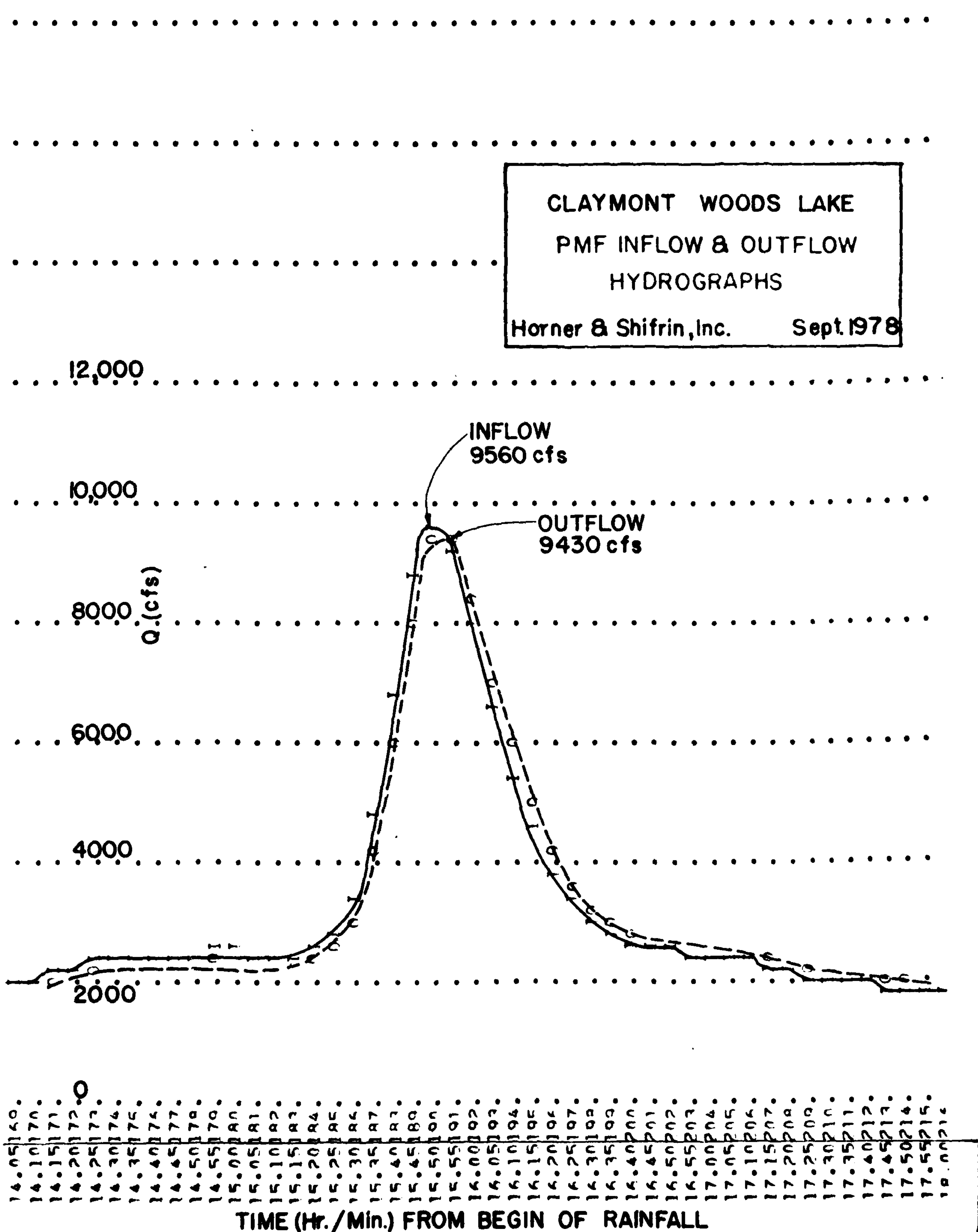
Horner & Shifrin, Inc. Sept. 197


ELEV. (M.S.L.)
Q Prin. Spillway
Q Aux. Spillway
Q Prin. S
565
564
563
562
561
560
559
558
557
0
1000
2000
3000
4000
5000
6000
7000
80


Q Prin. Spillway + Q Aux. Spillway
7000
8000
9000
10,000
11,000
CLAYMONT WOODS LAKE
DISCHARGE RATING CURVE
Horner & Shifrin, Inc.
Sept. 1978

2

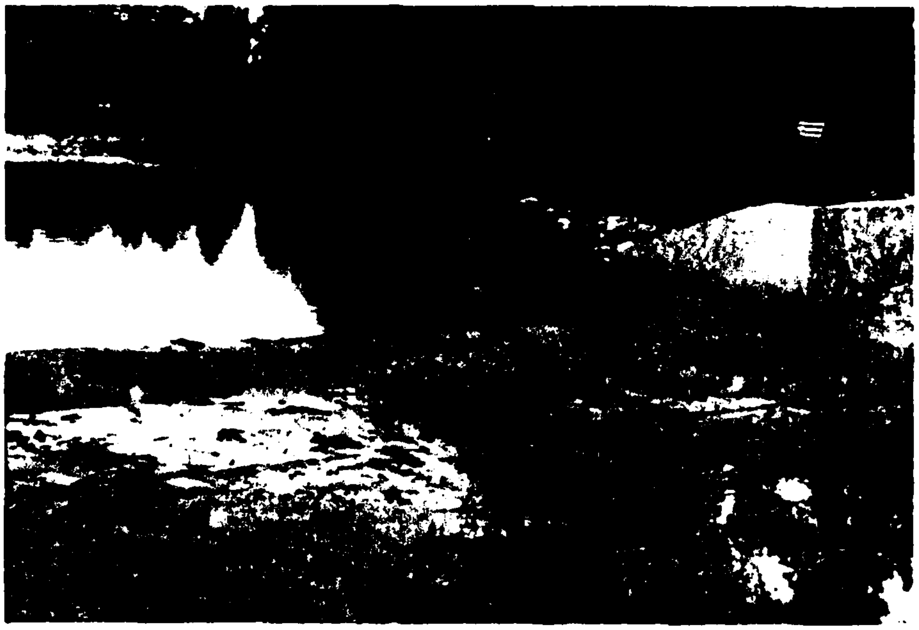
PLATE 19


CLAYMONT WOODS LAKE
PMF INFLOW & OUTFLOW
HYDROGRAPHS
Horner & Shifrin, Inc.
Sept. 1978
12,000
10,000
8000
6000
4000
2000
0
Q (cfs)
INFLOW
9560 cfs
OUTFLOW
9430 cfs
TIME (Hr./Min.) FROM BEGIN OF RAINFALL

APPENDIX

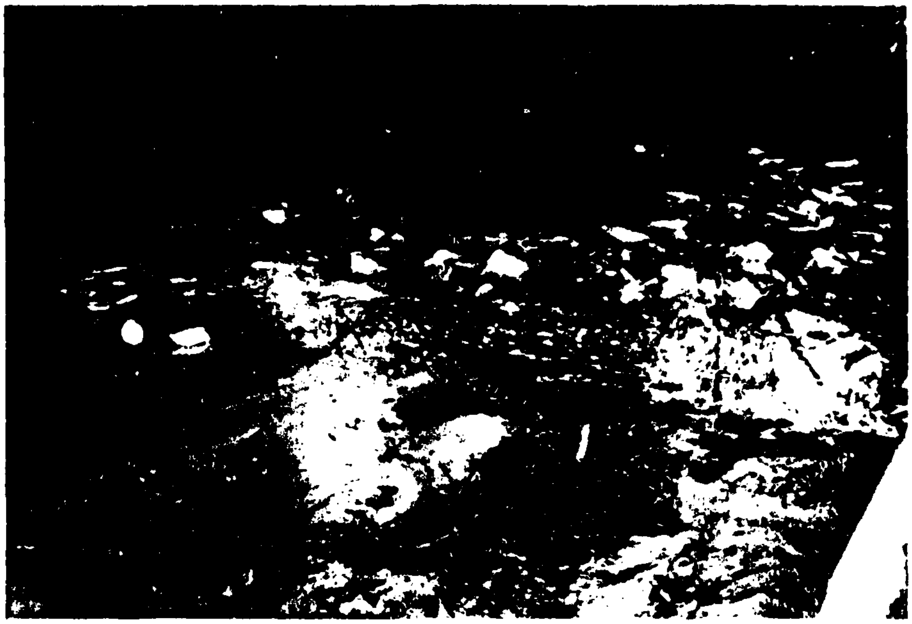
NO. 1: UPSTREAM FACE OF DAM

NO. 2: DOWNSTREAM FACE OF DAM



NO. 3: PRINCIPAL SPILLWAY CREST

NO. 4: SPILLWAY OGEE



NO. 5: OUTLET CHANNEL AT PRINCIPAL SPILLWAY

NO. 6: OUTLET CHANNEL BELOW SPILLWAY

NO. 7: JUNCTURE OF OUTLET CHANNEL AT CREEK AND DITCH

NO. 8: CONSTRUCTION JOINT AT PRINCIPAL SPILLWAY

HYDROLOGIC COMPUTATIONS

1. The HEC-1 Dam Safety Version (July 1978) program was used to develop inflow and outflow hydrographs and dam overtopping analyses, with hydrologic inputs as follows:

a. Probable maximum precipitation (200 sq. mile, 24-hour value equals 25.0 inches) from Hydrometeorological Report No. 33. One hundred year frequency (one square mile precipitation, 24-hour value equals 7.22 inches) from U.S. Weather Bureau Technical Paper No. 40.

b. Drainage area = 1.03 miles
= 661 acres

c. SCS parameters
Lag time = 0.30 hours
Soil type CN = 88

2. Spillway release rates for the principal spillway were based on the broad-crested weir equation:

$Q = CLH^{\frac{3}{2}}$ (C = 4.03, L = 40.5 feet), where H is the head on the weir crest.

3. The auxiliary spillway sections consist of broad-crested, approximately V-shaped earth sections for which conventional weir formulas do not apply.

Auxiliary spillway release rates were determined as follows:

(1) Spillway crest section properties (area, a and top width, t) were computed for various depths, d.

(2) It was assumed that flow leaving the spillway crest would occur at critical depth. Flow at critical depth (Q_c) was computed as $Q_c = (\frac{a^3}{t} g)^{0.5}$ for the various depth, d.

Corresponding velocities (v_c) and velocity heads (H_{vc}) were determined using conventional formulas.

(3) Static lake levels corresponding to the various Q_c values passing over the spillway were computed as critical depths plus critical velocity head ($d_c + H_{vc}$), and the relationship betweel lake level and spillway discharge was thus obtained. The procedure neglects the minor insignificant friction losses across the length of the spillway.

3. The combined outflow rating curve for flow over the principal spillway and the auxiliary spillway sections was obtained by adding corresponding discharges for given elevations. This rating curve is shown on Plate 18. Inflow-outflow hydrographs for the PMF are shown on Plate 19.

```
**********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION      JULY 1978
  LAST MODIFICATION  3 AUG 78
**********************************
A1      ANALYSIS OF DAM OVERTOPPING USING RATIOS OF PMF
A2      HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF CLAYMONT WOODS LAKE
A3      RATIOS OF PMF ROUTED THROUGH RESERVOIR
B      288       0       5      -0      -0      -0      -0      -0      -0      -0
B1       5
J        1       3       1
J1    0.15    0.50    1.00
K        0  INFLOW
K1      INFLOW HYDROGRAPH
M        1       2    1.03                     1.0                       1
P        0    25.0     102     120     130
T                                                       -1     -88
W2            0.30
X     -1.0    -.10     2.0
K        1     DAM                       2       3       1
K1      RESERVOIR ROUTING BY MODIFIED PULS
Y                                1       1
Y1       1                                            48.5      -1
Y4   557.7     558     559     560     561   561.4   561.8     562   562.3   562.6
Y4     563   563.5     564   564.5     565
Y5       0      30     240     570     980    1160    1390    1570    1970    2490
Y5    3400    4810    6470    8350   10510
$A       0     6.9     7.5     8.6     9.4
$E   536.6   557.7     560     563     565
$$   557.7
$D   561.4
K       99
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*********************************
FLOOD HYDROGRAPH PACKAGE (HEC-1)
DAM SAFETY VERSION       JULY 1978
  LAST MODIFICATION  3 AUG 78
*********************************
        A1       ANALYSIS OF DAM OVERTOPPING USING 100 YR FLOOD
        A2       HYDROLOGIC-HYDRAULIC ANALYSIS OF SAFETY OF CLAYMONT WOODS LAKE
        A3       100 YR FLOOD ROUTED THROUGH RESERVOIR
        B      288       0       5      -0      -0      -0      -0      -0      -0      -0
        B1       5
        J        1       1       1
        J1     1.0
        K        0   INFLOW
        K1           INFLOW HYDROGRAPH
        M        0       2    1.03                     1.0                       1
        O      288
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .014    .014    .014    .014    .014    .014    .014    .014
        O1    .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
        O1    .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
        O1    .014    .014    .014    .014    .014    .014    .014    .014    .022    .022
        O1    .022    .022    .022    .022    .022    .022    .022    .022    .022    .022
        O1    .022    .022    .022    .022    .022    .022    .031    .031    .031    .031
        O1    .031    .031    .061    .061    .061    .061    .061    .061    .132    .132
        O1    .133    .251    .251    .550    .823    .382    .251    .133    .132    .132
        O1    .061    .061    .061    .061    .061    .061    .031    .031    .031    .031
        O1    .031    .031    .022    .022    .022    .022    .022    .022    .022    .022
        O1    .022    .022    .022    .022    .022    .022    .022    .022    .022    .022
        O1    .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
        O1    .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
        O1    .014    .014    .014    .014    .014    .014    .014    .014    .014    .014
        O1    .014    .014    .014    .014    .014    .014    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007    .007    .007
        O1    .007    .007    .007    .007    .007    .007    .007    .007
```

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01   .007    .007    .007    .007    .007    .007    .007    .007
T                                                    -1     -88
*2           0.30
X    -1.0    -.10     2.0
K       1     DAM                       2       3       1
K1        RESERVOIR ROUTING BY MODIFIED PULS
Y                                1      1
Y1      1                                            48.5     -1
Y4  557.7     558     559     560     561   561.4   561.8     562   562.3   562.6
Y4    563   563.5     564   564.5     565
Y5      0      30     240     570     980    1160    1390    1570    1970    2490

Y5   3400    4810    6470    8350   10510
$A      0     6.9     7.5     8.6     9.4
$E  536.6   557.7     560     563     565
$$  557.7
$D  561.4
K      99
```